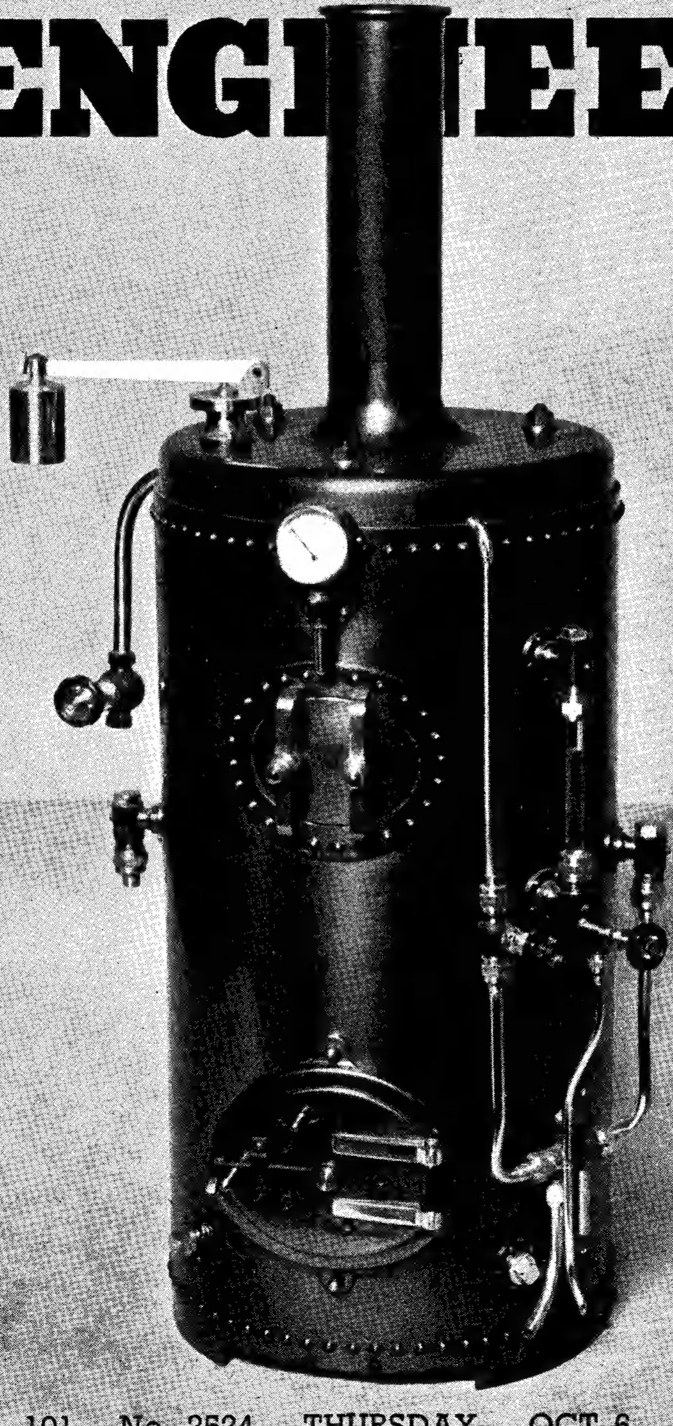
THE MODEL ENGINEER



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The MODEL ENGINEER

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SMOKE RINGS

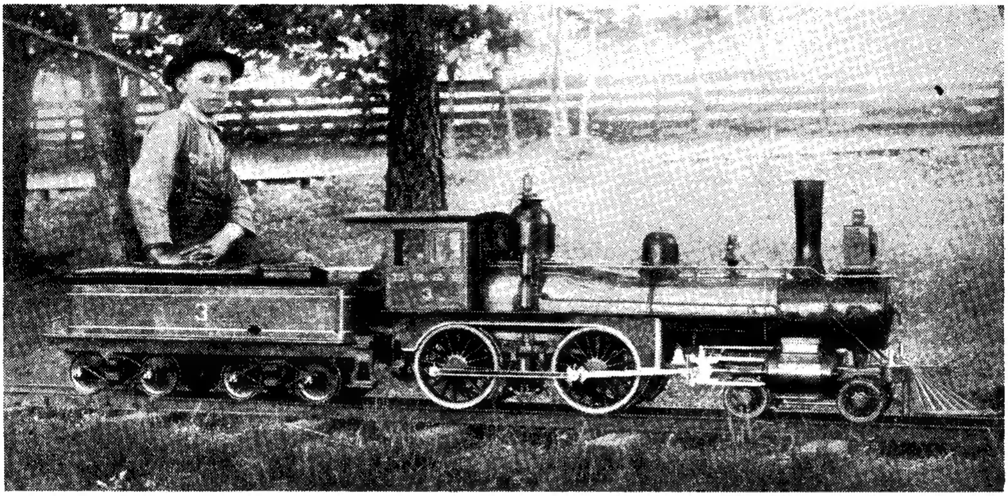
Our Cover Picture

● BOILER MAKING forms an essential part of the construction of all types of steam-driven models, but in the great majority of cases, the boiler is regarded mainly as a means to an end rather than as a complete model in itself. The methods used in full-size boiler making, have often been regarded as too tedious for application to model boilers, and it is customary to use the quickest methods of construction which give the desired results. The boiler in the photograph is an exception to this rule, being practically a true scale model of the well-known vertical multi-tubular type of boiler which has been extensively used in driving dockside cranes and contractors' portable steam plants, and often nicknamed a "coffee-pot." This particular example was constructed by Mr. S. T. Harris and exhibited on the stand of the London S.M.E.E. at the "M.E." Exhibition. It is constructed throughout of copper and oxydised to produce a glossy black finish which gives it a very realistic appearance.

Scientific Instrument Making

● THE ARTICLES on the subject of horological and scientific instrument construction, which have always been a popular feature of THE MODEL ENGINEER, have sometimes been criticised as being outside the scope of legitimate model engineering. There is, however, fairly conclusive evidence that these articles are appreciated by the great majority of our readers, even those who are not directly interested in this particular type of work; their value lies mainly in the object lessons which they provide on general engineering craftsmanship and methods of machining. The alliance between model engineering and scientific instrument making is, however, closer than a good many people realise. For instance, instruments of a fairly intricate type are often found necessary for the testing of models, and also for speed recording in competitive events. Model engineering societies have designed and developed such instruments as dynamometers, engine indicators, electric timers and strip chronographs, and it is evident, therefore, that the ability to carry out this class of work may be regarded as an essential part of the model-making faculty. Clocks and other instruments have always been a noteworthy feature of the "M.E." and other model engineering exhibitions, and it may be mentioned that at this year's exhibition, a very fine miniature bracket clock, and an ingeniously modified "Eureka" electric clock were featured. At the recent Worthing M.E. Exhibition, this class of exhibit was represented by an excellent long-

case clock, a Synchronome-type electric clock, and a disc recording machine, not to mention a complete electronic organ. At the Lincoln M.E. Exhibition, a very ingenious electric balance clock, and an equally outstanding example of a perpetual calendar were shown. It is, therefore, beyond all doubt that model engineers are interested in this class of work, and that articles in THE MODEL ENGINEER dealing with it will continue to be welcomed.



An Old American Miniature Locomotive

● THE PHOTOGRAPH reproduced on this page was recently loaned to us by a reader, who thought it might be of some interest to other readers. Unfortunately, no information whatever is available regarding the engine depicted, and in publishing our reproduction, we are hoping that some reader, possibly in America, may recognise it and supply us with particulars of its history and dimensions.

The eng ne is typically old-time American, is obviously well built and, although of simple design, it is very fully detailed ; it would appear to be about 2-in. scale, since it does not seem to be quite large enough for 15-in. gauge.

The original photograph is a fine old 10 in. by 8 in. P.O.P. print in good condition, though it is probably not less than fifty years old. But the engraving on the circular plate on the side of the smokebox is indecipherable, and what seems to be the only clue to the engine's identity is the initials " D.S. & S." on the cab-side.

From a New Zealand Reader

● WE HAVE received an interesting and chatty letter from Mr. A. E. Barsanti, of Palmerston North, New Zealand, who, writing on June 10th, states that " a few days ago, I received my copy of THE MODEL ENGINEER dated March 3rd." Some day, it may be possible for readers in that far-off Dominion to be in closer contact with us, as regards time, than is possible at present."

But Mr. Barsanti discusses a number of different subjects, the first of which is the " Smoke Ring " headed, " Model Engineering and Crime," which appeared in the issue he mentions. He heartily agrees with all the sentiments we expressed, and he asks if there is not a saying that " idle hands breed mischief." There is, and it is a profound truth.

Our correspondent goes on to say, however, that about two years ago, he had the pleasure of meeting an engineer who, by the way, just turns out first-class models, almost on a mass-production basis, and was associated with a model engineering society in Hamilton, N.Z.

This body was one of many which made use of a sort of Community Centre ; in fact, the model engineering society was looked upon as being almost the chief tenant. There was a well-equipped workshop measuring about 30 ft. by 25 ft., and, what is important, it was patronised by keen and energetic model engineers. The activities of the society made so great an impression upon the authorities that eventually, the courts came to make attendance at the society's gatherings part of the terms under which certain offenders were placed on probation. At one time, there were five probationers attending the model engineering section, which suggests that the courts thought very highly of the ideals that lie behind handicraft projects.

We certainly like this idea, and we commend it seriously to the attention of legislative authorities and the hon. secretaries of model engineering societies. We can well believe that most societies would look askance at the notion of taking delinquents, or prospective delinquents under their care ; but that is a difficulty which could be overcome. The point is that, if the delinquents could have their minds and energies directed into a healthy, intelligent and friendly atmosphere, and given a chance to forget the evil influence which causes attempts at crime, they would cease to be delinquents. We feel that this is a project that might well be given a trial, especially at a time like the present when juvenile crime is so distressingly on the increase.

The Growth of a Marine Plant

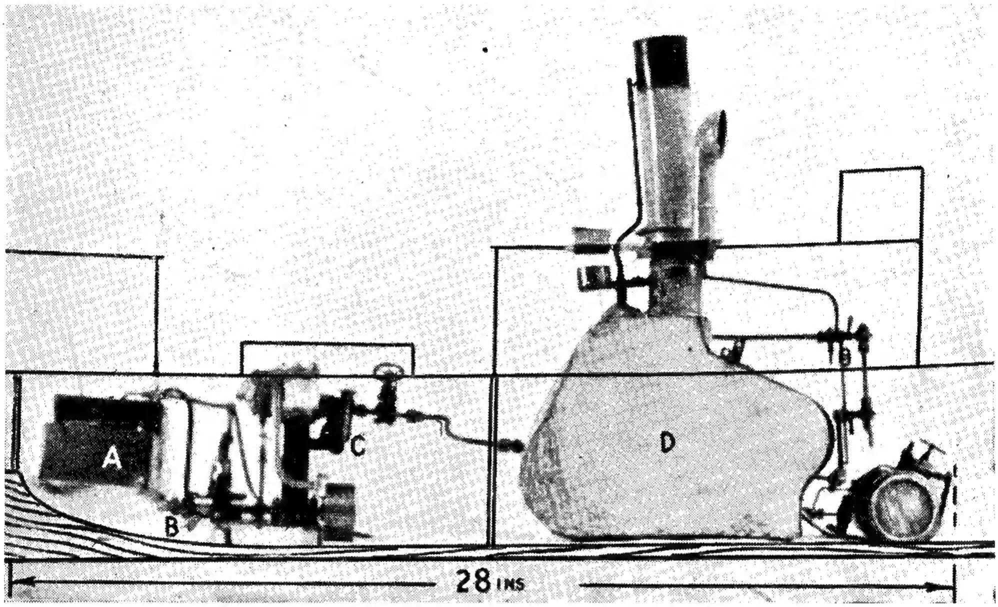
by R. Roberts

THIS article has nothing to do with the cultivation of seaweed, as the title may suggest, but is directed to modelmakers interested in building and running prototype model boats. Nothing new or out of the ordinary is claimed for the information given below, there being many boats, or let us say ships, with more complicated machinery seen on ponds up and down the country every day. Rather is it an outline of how from the first bare essentials, a simple installation can be added to by stages, thereby making it more interesting and reliable.

Let us assume that something faster steaming than the elementary pot boiler and methylated spirit lamp is desired. A centre-flue or water-tube boiler as recently described by Mr. E. T. Westbury, and fired by a blow torch, gives a greatly increased performance, and is the usual practice for hulls of around 4 ft. and 30 lb. displacement and upwards. Remember I am speaking of models, as distinct from miniature speed boats, which are not models of anything, whether round the pole or free running.

The plant described is based on my own experience and that of other club members.

The size of the engine is also standard, ¾-in. bore and stroke, single-cylinder, double-acting, with an ordinary slide-valve. The plant shown in the photograph was originally built without a lathe, the piston, turned on its rod, being the only "outside" job. Blowlamp, boiler, engine and hand feed-pump were all made with a hand drill as the only machine tool, price 1s. prewar. This, with an engineer's steel square, plus the ordinary hand tools, completed stage 1, as seen diagrammatically in Fig. 1. Admittedly, this required more time and patience than one human being should be called upon to produce, but the fact will, I hope, inspire those who hesitate to build models through lack of full equipment.



A photo-diagram of the main parts. A, the feed-water tank and hand pump. B, reduction gear and mechanical pump, C, engine, lubricator, and steam-valve. D, water-tube boiler and superheater

Fig. 1, then, is the beginning, but with a fairly fast-steaming boiler the hand feed-pump, Fig. 2, is a necessity. In my case it was put into an inside water tank, to save space, the tank being provided so that the boat could be run in salt water.

Thermal Efficiency and All That

The lamp container, filled to working level, holds just under ¼ pint; this would last about one hour at an economical cruising speed. The thermal efficiency when worked out with regard to the distance travelled was extraordinarily bad, roughly 63 miles to the gallon! But this compares favourably with other boats of its size.

The first improvement (on acquiring a lathe) was the addition of a mechanical feed-pump,

driven by reduction gear from the engine. This pump was $\frac{1}{4}$-in. bore by $\frac{1}{4}$-in. stroke, driven at $2\frac{1}{4}$ to 1 of the engine speed. At any boiler

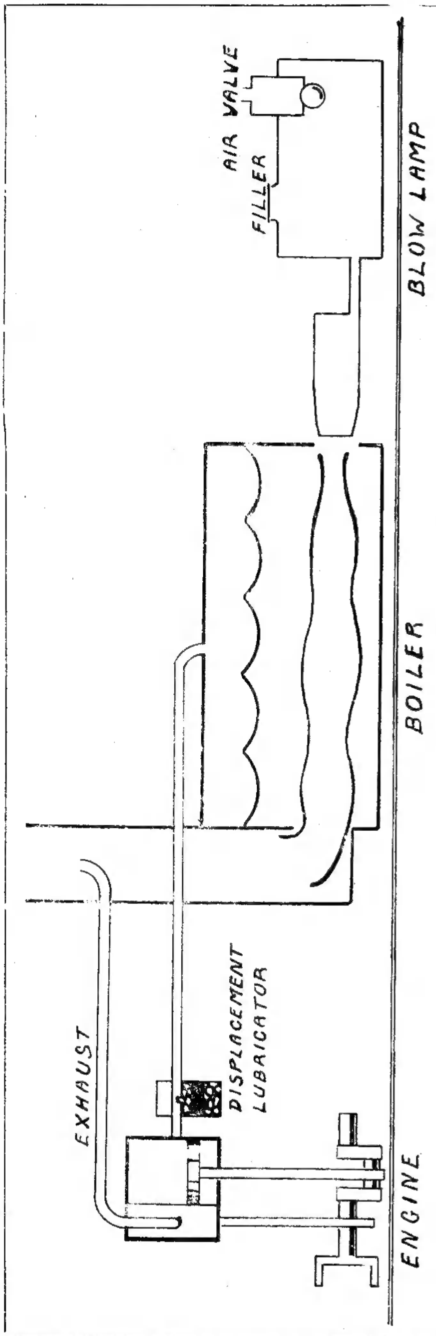


Fig. 1. The first stage—the bare essentials

pressure from 30 to 60 lb. per sq. in., this pumped more than enough water, and the by-pass had to be used.

Next, a condenser was added, consisting simply of taking the exhaust through a pipe outside the bottom of the boat and then into the feed tank, the pond water doing the cooling, of course. Between engine and " condenser " an oil separator was added. The steam is superheated, and the usual lagging is applied throughout, right to the exhaust side, including the separator, to prevent, as much as possible, the steam turning to water before reaching the condenser tube. When the boat is running flat out, the condensate in the feed tank is quite hot. This helps to counteract the other inevitable losses, both mechanical and thermic, when putting on maximum urge.

The separator works well, as no trouble has so far been experienced with oil in the boiler. A simple coil might be added in the water feed to boost the temperature even more—every little helps.

My next change was to double the size of the fuel container, and fit a slightly larger burner.

The Blessed Hush of Steam

Now the quest for improvement took on a new slant. Steamers, other than racing machines, should move almost silently. The roar of a blowlamp, and the grinding of gears, is out of place with the smooth unhurried grace of steam. Noise is not necessarily the companion of power.

Having already a silent type of blowlamp, I fitted a worm reduction gear of six to one to the pump. This runs in an oil bath. The pump stroke was increased to $\frac{5}{16}$ in., and precautions were taken to quieten the coupling to the propeller shaft. The result is an improvement, but the comments of strangers at the pond side are not encouraging. I hear the would-be expert assure his listeners that it is " clockwork " or " electric " ! Such insults !

The displacement lubricator has been replaced by an oil pump worked from the same gear. It has an adjustable stroke, $\frac{1}{8}$ in. being used, with a bore of $\frac{1}{16}$ in. I suspect that the valves are not quite right, as the stroke should not have to be so much.

This brings us to the last stage, as shown in Fig. 3. The one further step I hope to take with this particular boat is to pump fuel mechanically into the pressure tank from an " open " tank in the engine room. This means that instead of being able to steam only $4\frac{1}{2}$ miles in $2\frac{1}{2}$ hours (the present capacity of the tank), she will be able to go at full speed just so long as the open tank is topped up, and the small water losses made good.

The Proof of the Pudding

Owing to a certain rudder setting and the vagaries of the wind, my boat circled for forty-five minutes in half a gale without once coming near the bank. This with no more ill effects than some water in the engine room, quickly squirted overboard by the bilge ejector. Certainly this test was not made according to a prearranged plan, but it at least shows some measure of reliability.

Question :—Has anyone tried to steam a scale model across the Channel ? A chance for the radio-control boys.

I consider Mr. Westbury's articles " Utility

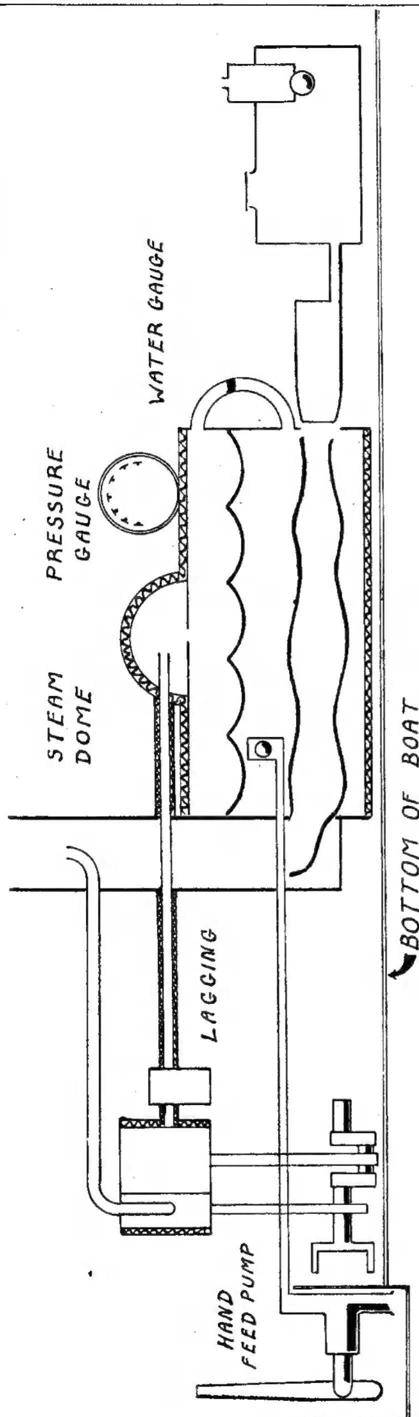


Fig. 2. Add boiler fittings, lagging, and a hand feed-pump

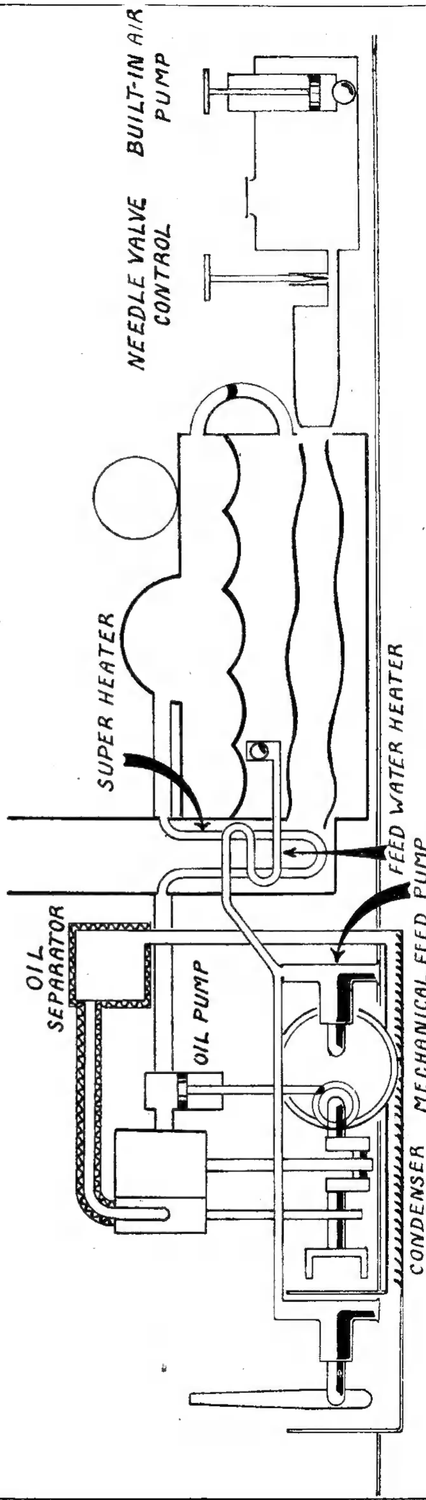
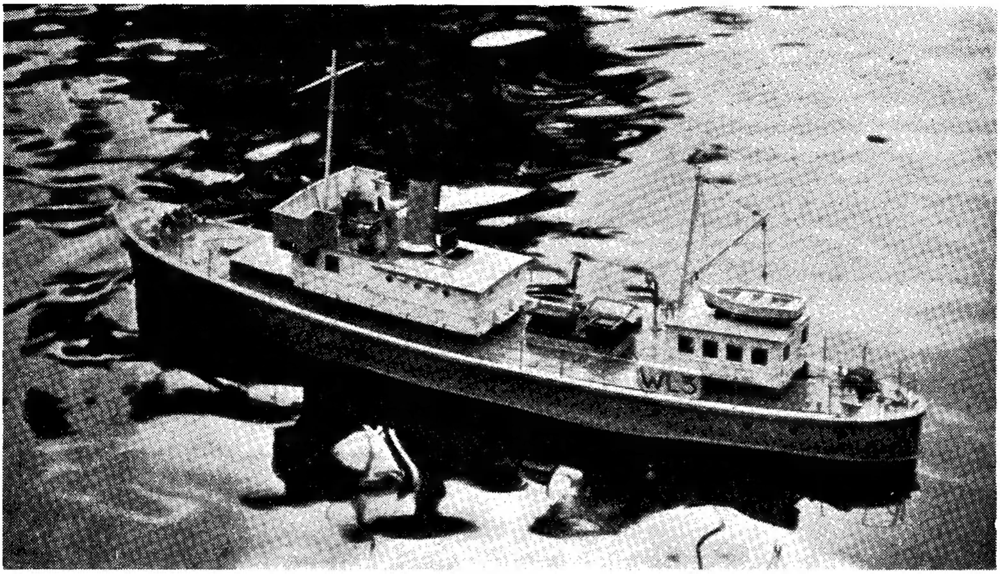


Fig. 3. Every mod. con.! Engine-driven pumps, condenser, steam and water heaters



A 4 ft. model containing the plant. Built to a scale of ½ in. to the foot. Full speed about 4 knots

Steam Engines " are excellent, and long overdue. However, having watched the sometimes bitter experiences of the owners of centre-flue boilers, I should say that the one shown in the article on page 733, June 16th issue, needs three times as many cross tubes, for the following reasons :—

To ensure that the lamp is neither blown out nor backfires, it is common practice to direct the exhaust steam up the funnel. This creates sufficient draft to counteract any wind gusts so long as the engine is running, but with a good pressure in the boiler and a sudden opening of the throttle, the flame is drawn off the lamp, and it goes out. Contrarywise, when the engine is not working, a puff of wind down the funnel may put it out quite easily.

If there are an adequate number of cross tubes in the flue, they act as a damper in both directions and the above effects are largely nullified.

While most builders are content to stop at stage 3 (minus the condenser arrangement), there are some whose enthusiasm carries them much further—into the mysterious realms of stage expansion.

It is all too seldom that we hear of a triple-expansion engine (with reverse gear), condenser, vacuum and water circulating pumps, etc. being installed in a working model.

As far as can be ascertained, mechanical efficiency is not particularly increased by these refinements, and the complications of servicing and upkeep greatly added to. But—and here is the crux of the whole matter—the tremendous fascination of a fully equipped engine room, with all its pumps, valves, and levers, together with the satisfaction of having made it all work, is worth more than a little trouble in the accomplishment.

For the Bookshelf

The Rother Valley Railway, by M. Lawson Finch. (Published by the author at Castleton, Dunton Green, Sevenoaks, Kent.) 80 pages, size 5¾ in. by 8¾ in. Fully illustrated on art paper.

The full title of this interesting book is *The Rother Valley later the Kent and East Sussex Railway*, and this fascinating little railway is probably much more familiar as the K.E.S.R. The book records the history of the line from 1896 to 1948. As is usually the case with the minor railways of Britain, the story is a fascinating one, fraught with amusing and not-so-amusing incident, carefully collated and recorded. Every feature of the railway, whether geographical or mechanical is described and, in many cases, illustrated. A slip in the caption to the photograph on page 64 requires correcting in future editions, so that it shall agree with the paragraph at the bottom of the same page.

The book is another worthy addition to the growing list of literature dealing with the history of Britain's light railways, and should not be missed by anyone interested in the subject.

Voltmeters, Ammeters and Ohmmeters

by A. R. Turpin

IT can be said, quite safely, that at some time or other most readers require an electrical measuring instrument, and if you have not got one, now is the time to get one with the "surplus" stores full of excellent basic instruments at very low prices. With this in mind I thought that a few words on the subject would not be out of place.

In a well-made instrument the deflecting force is proportional to the current, and the restoring force of the springs is proportional to the deflection; therefore, the movement of the pointer across the scale will be proportional to the current, and the scale will be uniform. The chief error that has to be overcome in this type of instrument is the temperature error;

Photo No. 1. Various types of government surplus instruments

In the main, there are three basic types of instruments, the moving iron, the moving coil, and the thermo-couple, but for general use the moving coil is the best instrument, and it is this that I propose to discuss.

For the uninitiated a brief description of the instrument is as follows; a coil of fine copper wire, wound on a rectangular metal former, is pivoted at each end, with the sides of the coil lying in air gaps formed by the poles of a strong permanent magnet, and a cylindrical iron core. When a current is passed through the coil it is deflected at right angles to the field of the permanent magnet, and in so doing moves a pointer attached to one of the pivots. The current is led to the coil by means of phosphor-bronze helical springs, which also act as the restoring force for the coil.

this is caused by the high coefficient of resistance of the copper wire forming the coil. This can be overcome, to a large extent, by including in series with the coil a resistance with a low coefficient, having a value three or four times that of the coil; this is called a "swamp" resistance. The material used for the "swamp" resistance is usually "manganin" wire, or similar material. When a moving coil instrument is to be used as a voltmeter, the resistance of the coil is negligible compared to the total instrument resistance, and this swamping resistance is often omitted from the basic instrument; special notice should be taken of this when buying a voltmeter movement to use as a universal instrument.

A glossary of terms likely to be met with in advertisements is as follows :—

Full Scale Deflection (F.S.D.)—The current,

or voltage required to move the pointer to the extreme end of the scale, usually stated in micro-amps, milliamps, millivolts, or volts.

Internal resistance—The resistance of the coil plus the swamping resistance.

Resistance per volt—The resistance of a volt-meter for every volt of the scale; that is to say a meter with a 10-volt scale having a resistance of 1,000 ohms per volt would have a total resistance of 10,000 ohms.

Parallax dials—A dial with a strip of mirror fitted behind the blade of the pointer so that by the reflection of the pointer it is possible to tell when the eye is directly over the pointer, and so avoid alignment errors.

Flush mounting—The body of the instrument is sunk into the panel.

Panel mounting—The body of the instrument stands proud of the panel.

Dead beat—This refers to the damping of the needle. If a sudden change is made to the current passing through the coil, on some instruments the pointer will oscillate about the point of final reading, on others the needle will move slowly across the scale and stop dead on the new reading; the latter is a "dead beat" instrument.

When purchasing an instrument, all of the foregoing points should be taken into consideration. Although, obviously, an instrument with a low F.S.D. has its advantages, it must be remembered that not only are they less robust as the sensitivity increases, but also their internal resistance also increases. For workshop use, a meter with an F.S.D. of one milli-amp, an internal resistance of 100 ohms, and a scale of $2\frac{1}{2}$ to $3\frac{1}{2}$ in., would be quite a useful basis for a multi-range instrument.

Photo No. 1 shows a number of "surplus" instruments, the top left-hand one had a scale $2\frac{1}{2}$ in. long which was originally marked 0-700, and underneath "Thousands of feet of cable," this was being sold at a very low price because of the peculiar scale, but was actually a very fine piece of work having a dead beat movement, an F.S.D. of $2\frac{1}{2}$ mA, and an internal resistance of 50 ohms. As can be seen, a new scale has been fitted, this is of the panel mounting type.

The top right-hand instrument is what I believe is called a "beam track indicator," and was fitted to most bomber aircraft for "homing." The two needles are actually attached to the movement of two micro-ammeters; as fitted to the instrument, they have a restricted movement of about 30 degrees, but with modifications they can be converted to two meters having at least a 90 deg. arc, a full scale deflection of about 150 mA, and an internal resistance of approximately 1,000 ohms, they cost only 6s.!

The bottom left-hand meter as purchased, had not the necessary series resistance to suit the reading of the scale, and as it stands has an F.S.D. of 600 mA, and a resistance of 310 ohms; this is a flush mounting type. The meter next to the last was originally a thermo-couple ammeter, reading 0 to .5 A; these instruments can be used for a.c., but have the drawback that they will stand no overload, have a square law scale, and take considerable power; they are therefore not much use in the normal workshop. The actual instrument illustrated has had the "couple" removed and operates as an ordinary moving coil meter. It is very poorly damped, but as it is used as a pyrometer head this does not matter, because under these conditions, there is never any *sudden* change of current. Its internal resistance, as it stands, is only a few ohms.

The last, bottom right-hand meter was also a thermo-couple type, reading originally 0-3 A, and again has had the couple removed; it is used as a voltage indicator on a charging board. This instrument was picked out of a bucket on a market stall, and cost only a few pence!

Now let us imagine that we have purchased an instrument having a $2\frac{1}{2}$ in., scale, an F.S.D. of one milliamp, an internal resistance of 100 ohms, and a scale reading 0-500 V. We may be quite unaware of these figures when we purchase the instrument, all we know is that the scale reads 0-500 V. We must first, therefore, find out if the instrument will really measure this 500 V, not by applying such a high voltage to it; but by connecting it to a low voltage supply, say a 4.5 V flash-lamp battery with a 10,000 ohm resistance in series with it; if the needle moves some way across the scale, the necessary series resistance is not incorporated, but if the needle only flickers, it most likely is. Remove the cover by unscrewing the three screws round the periphery of the case and withdraw the cover with a straight pull—on no account give it a twisting motion or you will damage the zero setting mechanism, the screw of which can be seen on the front of the case. The movement will now be exposed, and if the series resistance is incorporated, it is usually in the shape of a small wire-wound bobbin, but be careful that you do not mistake the swamp resistance for it.

Let us suppose that no series resistance is incorporated, but we wish to find the F.S.D.; our first test will have told us that, and in this particular case we should have moved the pointer to the 225 V mark on the dial, from which we know that the F.S.D. will be one milliamp, 4.5 V $\div$ 10,000 ohms $= .0045\text{ A} = \frac{45}{100}$ of F.S.D.

To find the internal resistance, a known resistance is connected across the terminals of the meter with the battery and original resistance still connected to it, and the difference in the reading noted; if the reading has been reduced by one fifth, then the exterior resistance is four times the resistance of the meter, if the reading is halved, the resistances are the same and so on; a calibrated variable resistance is handy here. Let us imagine that we have shunted the meter with a 50 ohm resistance, and the reading drops from 225 V on the scale to 75 V, i.e. one third of the original reading, then the internal resistance will be twice the shunt resistance, or 100 ohms.

We now know all we want to know about this instrument to be able to use it for any purpose, but let us first draw a new scale reading 0-100. This can be done very neatly if the scale is drawn, say, four or more times the correct scale and then photographed down to the original scale size; if you have no enlarger, this can be done directly in the camera using bromide paper in place of a film, and moving the drawing nearer or farther from the camera until the correct scale size

is obtained; if no focusing screen is available, make one from a piece of ground glass held to the back of the camera with rubber bands.

If the scale is drawn in reverse, the negative scale can be used—see the first instrument in Photo No. 1—or the negative may be printed

of the meter, and n the "multiplying power." Thus if we require to make our instrument read up to 10 A, $R = \frac{100}{10{,}000 - 1}$, in this case we can ignore the "minus one," and our answer will be $R = 0.01$ ohms. With lower readings, the

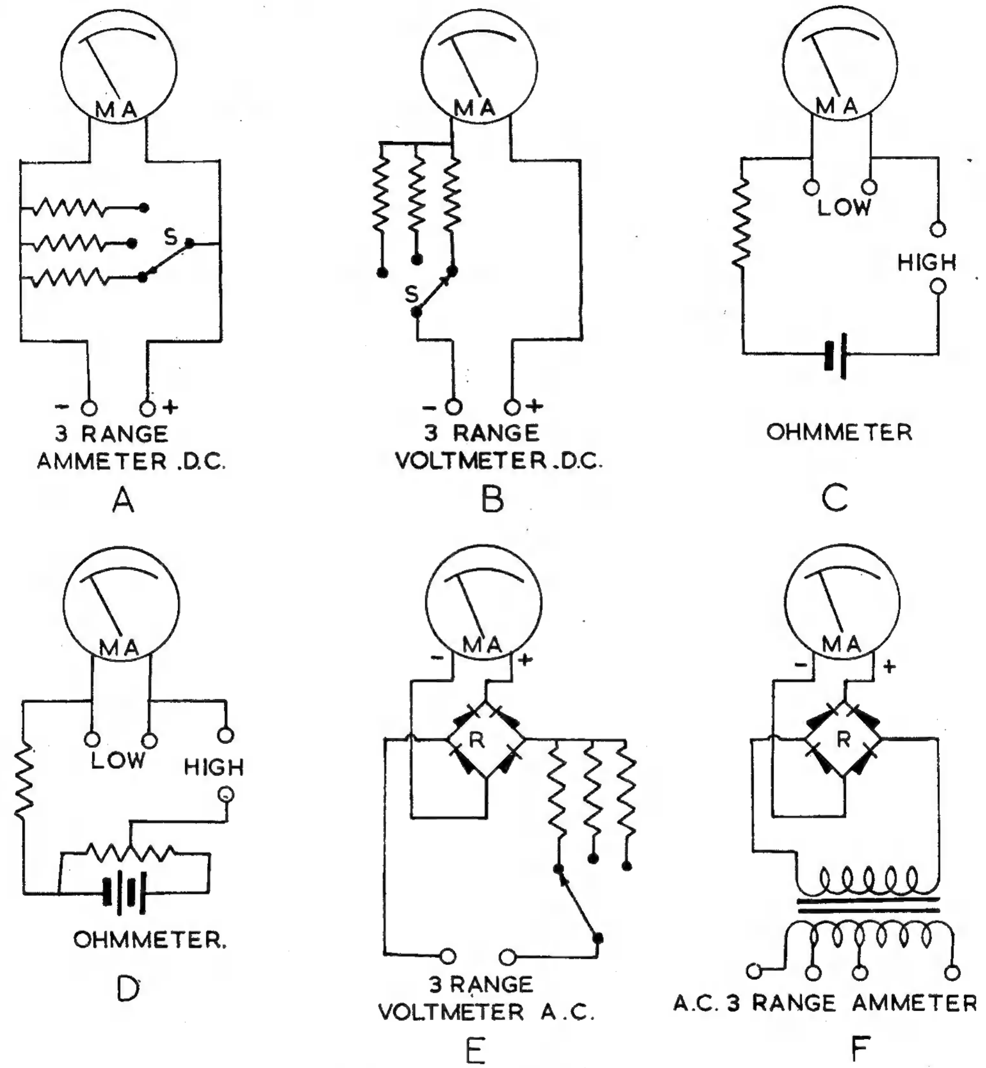


Fig. 1. Basic circuit diagrams

by contact on to a second sheet of bromide paper.

Having obtained our new scale, we are now ready to proceed to construct any type of meter. As it stands, it will be capable of measuring currents up to one milliamp, but with the aid of shunts as shown in Fig. 1 "A" we can measure any size current we like, the equation for calculating the resistance of the shunts is $R = \frac{r}{n - 1}$, where R is the shunt required, r the resistance

"minus one" becomes an appreciable part of the answer and must then be subtracted.

The shunts should be constructed of resistance wire having a low coefficient of resistance such as "manganin," and should be wound non-inductively if to be used with a.c. Typical shunts are shown in Photo No. 2 "A."

To measure voltages, we need a series resistance, and from Ohm's law we know that a definite voltage is required to force a definite current

through a given resistance, so we place a known resistance in series with our instrument and measure the current flowing.

Thus, if we place a series resistance of 10,000 ohms between the battery and the meter, as shown in Fig. 1 "B," and the reading shows .5 milliamps, then the voltage of the battery is 5, or if it reads 7.5 and the resistance was 100,000 ohms the voltage would be 75. This is not quite accurate, as we have ignored the resistance of the meter itself, which is quite appreciable on the lower voltages and is shown in the basic equation $R = \frac{V}{i} - r$, where R is the series resistance required, V the full scale voltage, r the resistance of the meter, and i the F.S.D. in amps; thus to convert our meter to read to 10 V we substitute as follows : $R = \frac{10}{.001} - 100 =$ 9,900 ohms.

Suitable series resistances are those used in radio of the $\frac{1}{4}$ W size or larger, and are shown at "B," Photo No. 2.

To measure resistance, the meter can be used in a number of ways, but the simplest is to place the unknown resistance in series with the meter and a battery of known voltage, and from the equation $R = \frac{V}{i} - r$, where V is the applied voltage, i the current flowing through the meter, and r the internal resistance of the meter, find its value.

Alternatively, we can arrange a resistance and voltage that will give F.S.D. of the meter, place a resistance in shunt with it, then reverse the process we used to find the resistance of the meter. This latter method is useful for measuring low, and the former, high resistances, see Fig. 1 "C". The foregoing methods are simple, but have drawbacks, and a better arrangement is shown at "D." Here we have a potentiometer of, say, 200 ohms across a battery of 1.5 V, and so arranged that when a 1,000 ohms resistance is joined in series with the meter, we can adjust the applied voltage to give full scale deflection with the "high" resistance terminals shorted; if the unknown resistance is connected across the terminals in place of the shorting wire, the value will be $R = \frac{V}{i} - r$. This is similar to the previous equation, but here r represents the series plus meter resistance, in this case 1,100 ohms. Shunting the meter is carried out as previously described, but with the "high" resistance terminals shorted. The advantage of this method is that we are not likely to damage the meter if a very low resistance is inadvertently connected across the terminals, and the voltage can be adjusted as the battery gradually runs down.

(To be continued)

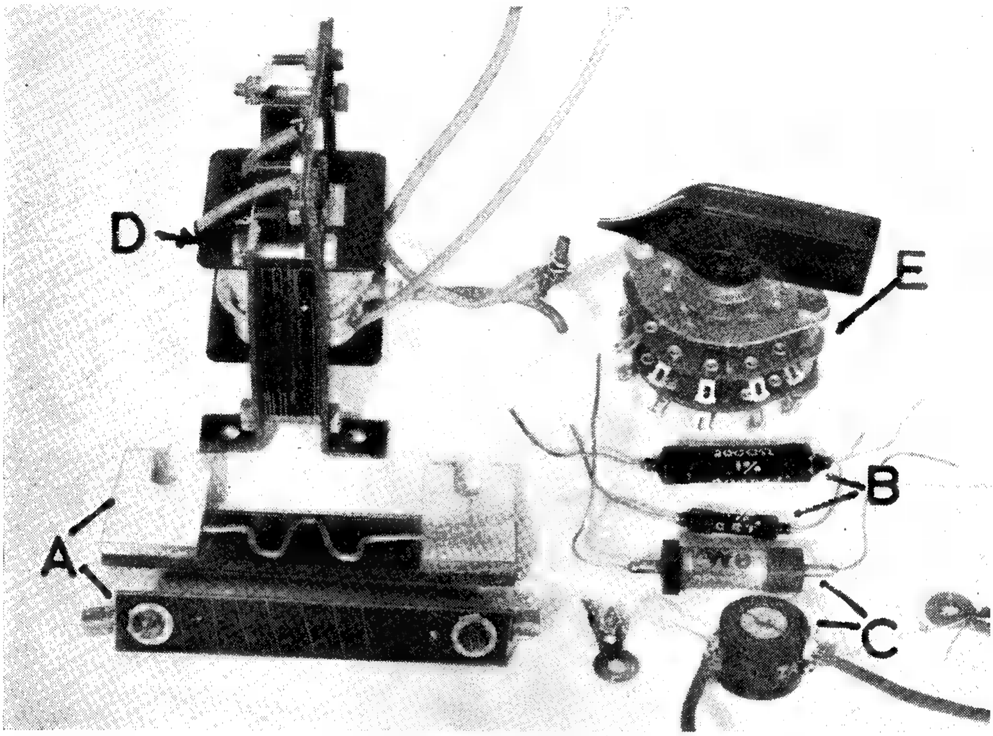


Photo No. 2. "A," shunts; "B," resistances; "C," instrument rectifiers; "D," current transformer and "E" wafer switch

Slide-rest Control Modification

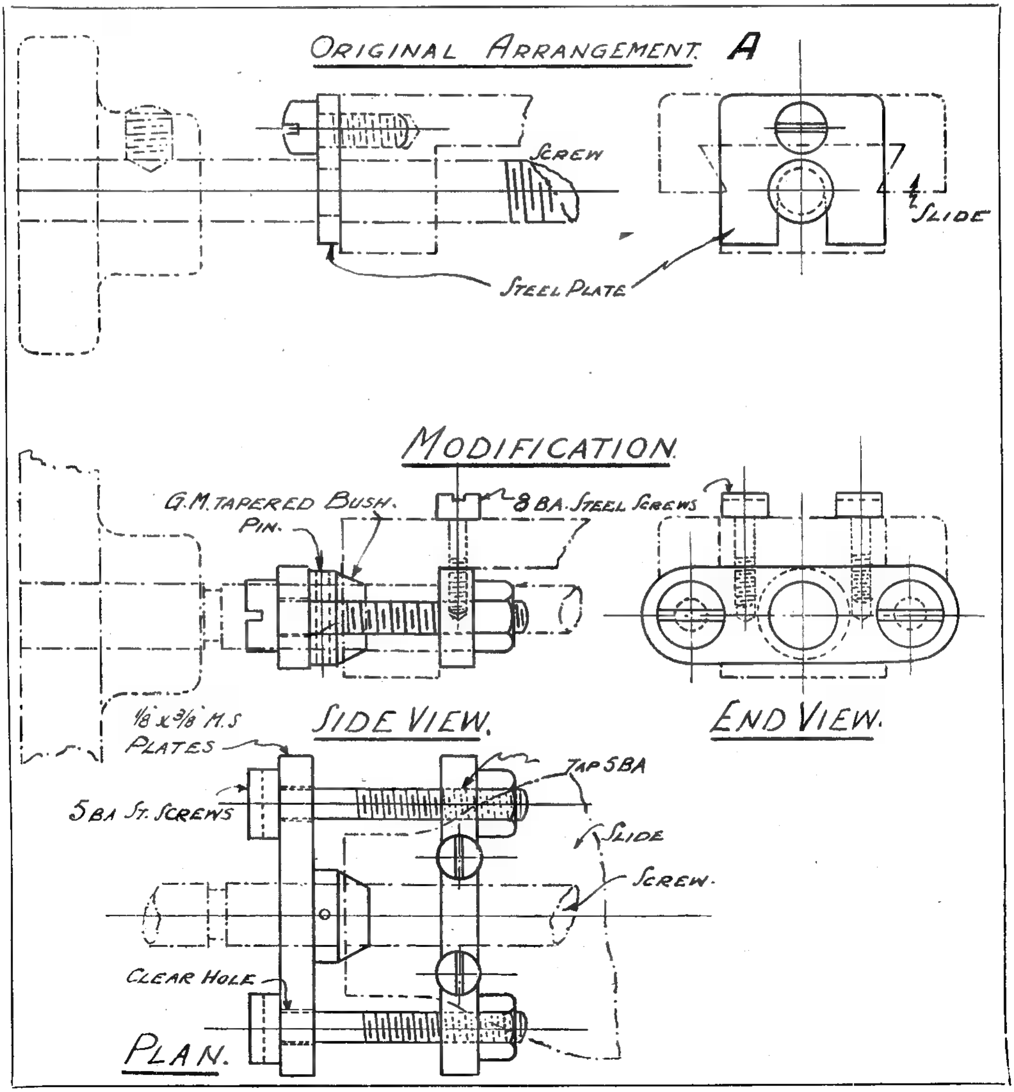
by W. F. Yates

MANY types of small lathes for the model engineer at present on the market, have their slide-rest operating screws, located by a steel plate slotted to fit over, and into, a recess, and screwed to the front of the slide.

The thrust surfaces obtained by this method are soon worn, and backlash develops to such an extent, and in so short a time, as to be very annoying. This arrangement is as shown at (A) in the drawing.

I have made a modification to my lathe, which is so successful and, so smooth in operation, that it may be of interest to those fellow modellers who possess this type of lathe, and find the difficulties which I found. The pleasant control which is obtained, makes it worth while to carry out the modification, particularly as no cost is involved, my own modification having cost me *fourpence* for four 5-B.A. screws and nuts

(*Continued on page* 445)



*UTILITY STEAM ENGINES

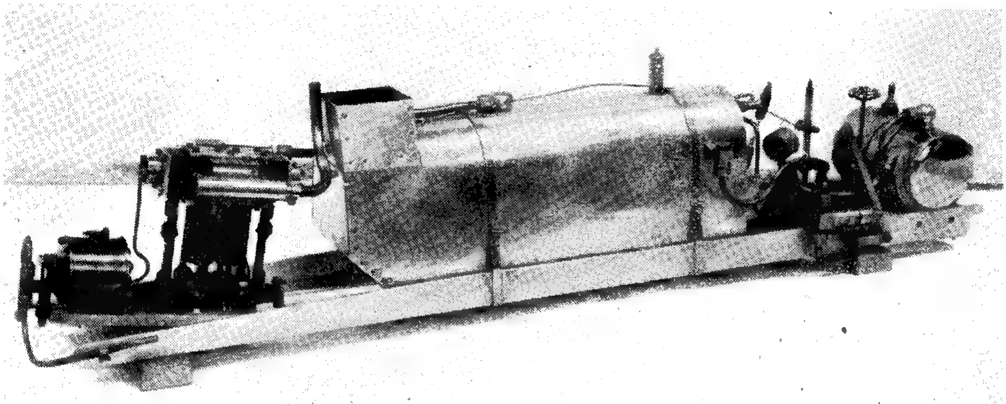
by Edgar T. Westbury

IN simple steam plants with pot boilers having a reasonable water capacity for the size of engine, the provision of any means of replenishing or continuously feeding the boiler is often regarded as unnecessary. Such boilers are usually filled by removing the safety-valve, or some other suitable plug, and will run for a sufficient length of time for normal requirements, after which pressure must be allowed to die out, so that the boiler can be filled as before. If, however, it is necessary or desirable to keep a boiler under steam for fairly long periods, some form of feed-pump or its equivalent becomes necessary.

In some cases, a hand feed-pump will serve its required purpose, and such pumps can be of quite simple design, provided that they are capable of working at a sufficiently high pressure to overcome the pressure of steam inside the boiler. It is hardly necessary to deal with the design of these pumps, as the form of pump used on a locomotive and usually fitted in the tender is quite suitable, and it has been described in THE MODEL ENGINEER on numerous occasions.

To eliminate the need for hand operation of the feed-pump, the obvious thing is to drive the pump from the engine itself, and in this case also, there is a good deal of information available on suitable types and arrangements of feed-pumps, which have been described in connection with locomotives, traction engines, and other forms of steam plant.

One of the first problems which is likely to arise in designing a feed-pump for a given type and size of plant, is to decide the output of the pump required to maintain the feedwater supply, and keep the water-level in the boiler constant under the normal working conditions. Apart from the actual displacement of the pump, the speed at which it operates will also affect output, and the pump may either be driven direct from the engine, or geared to it at any suitable speed reduction ratio. For engines which have to work at comparatively slow speeds, it is fairly obvious that the simple arrangement of direct drive is preferable, but many of the small engines used for marine work run at such a speed that it would be difficult to ensure efficient functioning of the pump, if driven direct, and reduction gearing, therefore, becomes desirable, if not absolutely necessary.



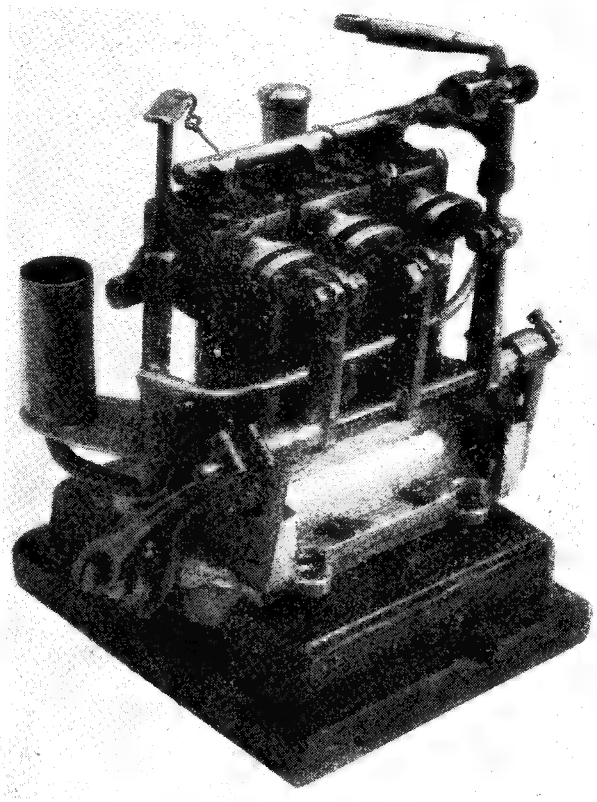
Seen at the "M.E." Exhibition. (1) *A complete marine steam plant, comprising water-tube boiler, blowlamp and double-acting twin engine, by Mr. J. Jepson (Blackheath M.P.B.C.)*

I am often asked to advise readers as to a suitable size (i.e. bore and stroke) of feed-pump, and rate of reduction gearing to suit an engine of a given size and type. It is, however, impossible to assess the required pump output for an engine of given size or performance, as the amount of water required may vary considerably according to the torque and speed of the engine. For instance, in the case of a marine plant, the power applied to the propeller may be much the same, whether using a large slow-running propeller, or one of much smaller dimensions running at higher speed. In the former case, a comparatively large size direct-driven pump would be required, while in the other, a smaller pump, or one of the same size geared to run at say 1/3 or ¼ engine speed, would be suitable. The only basis for calculation of the feed-pump output is the normal rate of evaporation of the boiler when running under its usual working conditions, and it is very rare that this figure is available unless very careful steaming tests have been made.

As already mentioned, a feed-pump driven by the engine is a great convenience on any boiler

**Continued from page 391, "M.E.," September 22, 1949.*

which must run continuously for appreciable periods, but its importance increases as the water capacity of the boiler is reduced in relation to steaming capacity. For instance, a centre-flue boiler with a large water capacity is much less dependent on a continuous supply of feed-water than a water-tube boiler having a small water capacity, and, of course, as already explained, an engine-driven feed-pump or its equivalent is a positive necessity in the case of a flash boiler. In most cases, when deciding the size of pump to be fitted to any particular plant, it is best to err deliberately on the large side, so that one can be quite certain that the maximum capacity of the pump is quite adequate for supplying the required amount of water under the heaviest steaming conditions, as it is much easier to cut down the volume, than increase it in emergency. Excess water from the pump can be by-passed by a small stop-cock or valve, or pump output may be reduced either by altering the ratio of the driving gear or decreasing the pump stroke.



(2) *A three-cylinder single-acting engine with separate overhead slide-valves, actuated by rocking levers, by Mr. E. W. Vanner (Victoria M.S.C.)*

For plants which are always directly under manual control, the by-pass valve is quite a sound method of control, as it is a very simple matter to adjust the valve to compensate either a rise or a fall in the water shown in the gauge glass of the boiler, but where the plant is required to be completely automatic, there are objections to this method of adjustment, and it is much better to arrive at a more positive method of metering. Some very ingenious devices for the control of feed-pump output have been designed, such as some form of link motion between the pump and its driving crank or eccentric, and these have the advantage that they can be adjusted while the plant is running, but a practical and much simpler method is to use a crank or eccentric of variable throw, which can be adjusted only when the engine is standing. In many flash-steam plants, a disc crank is used for driving the pump, having a detachable crank pin, which may be fitted to any one of a number of holes at varying radii in the disc. When such an arrangement is fitted, it is very desirable to arrange some means of moving the pump barrel when the stroke is adjusted, so that the plunger always has the minimum amount of clearance in the barrel at the end of the stroke.

Details of Feed-Pump Design

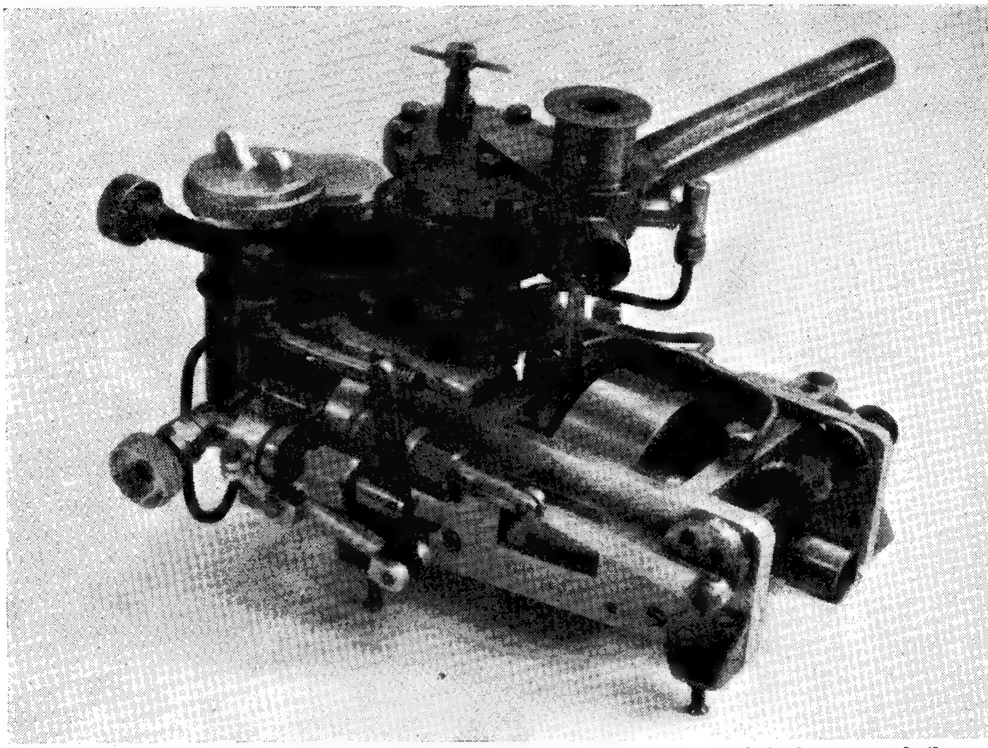
Although the simple single-acting gland-packed plunger type of pump is very difficult to improve upon so far as its basic design is concerned, much can be done by taking care with the details of the pump to ensure its complete reliability and efficiency for its particular purpose.

Perhaps the most common faults in feed-pump design are inefficient or unreliable valve action, and excessive clearance in the valve chamber. In some cases, pumps which work reasonably well at low speed lose volumetric efficiency, or fail altogether when speeded up, and the usual cause of this is bad arrangement of the valves, often coupled with excessive lift, which causes them to be sluggish in returning to their seatings after lifting, and also, in some cases, to bounce, instead of seating promptly and positively. The remedy in such cases, is to limit the lift of the valves, and to arrange matters so that they can only lift vertically. The effect of excessive valve chamber clearance is the formation of an air-pocket, which may also reduce output or cause complete failure, especially at high speed.

It is almost impossible to prevent the entry of a small amount of air to the barrel of the pump, as a certain amount of air is always present in water, particularly if it is agitated, and also some slight leakage may take place in the most carefully fitted glands, and pressure joints. So long as the amount of air admitted is not excessive, it will pass right through the pump without having and harmful effect, and may, in fact, be

beneficial by acting as a cushion and reducing shocks on the valves and pipeline. In large pumps it is often admitted deliberately for this purpose, but if a pocket exists, particularly if it is near the top of the valve chamber, where the air can remain undisturbed by the sweep of the plunger, there is a tendency for the air drawn in by several successive strokes of the pump, to collect until it forms a pneumatic cushion of sufficient volume to expand and contract an amount equal to the valve displacement; and when this happens, no water at all is delivered by the pump, and it is said to be "air-locked." An obvious remedy for this state of affairs is to reduce the clearance space in the pump, so that the very minimum amount of room is allowed for an air cushion to develop. A good deal of careful work has been done on this matter by the designers of small locomotives, and the lessons which they have learned may be used to advantage by constructors of other types of steam plant.

It should, however, be realised that many steam plants of the type now under discussion work under much more exacting conditions, particularly in respect of working speed and delivery pressure, than the usual locomotive feed-pump. For instance, many existing flash-steam plants have engines which will run at a speed of 10,000 r.p.m. or more, and the feed-pump, geared at say 5-1 reduction from the engine, will, therefore, operate at 2,000 strokes per minute, which is very considerably more than is ever encountered with the axle-driven pump on a locomotive.



(3) *Mr. A. Rayman's single-cylinder single-acting engine for flash steam, with feed-water and oil pumps (Blackheath M.P.B.C.)*

Valve Arrangement

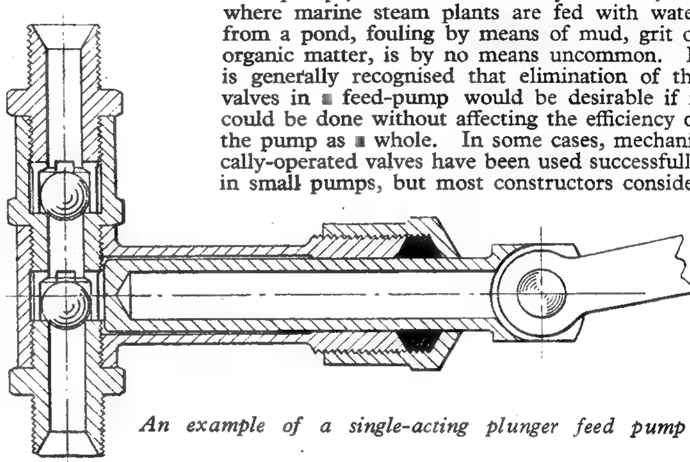
The usual type of valve used for suction and delivery in small pumps is the ball-valve, which is now almost universal, but it may be questioned as to whether this is really the most efficient or reliable type of valve for the purpose. Many years ago, Mr. H. H. Groves used small "wing" or "mushroom" valves for the feed-pumps of his highly successful flash-steam plants, and there is very good reason to believe that this type of valve is not only more efficient than the ball-valve, but also facilitates good design of the valve chamber of the pump. Any kind of lift valve, that is to say, a valve which is operated by the fluid passing through it on the suction or delivery strokes, must necessarily require a certain amount of effort to open it, and it will take a certain interval of time to either open or close.

In a well-designed pump, both of these factors should be reduced to the minimum, and, therefore, the lightest possible valve in relation to the size of port which it operates, will obviously be the most efficient, provided that it serves the essential purpose of sealing the port completely when closed. The effort required to lift the valve is supplied by the difference of pressure on its

two sides, and is an important factor in the mechanical efficiency of the pump.

A large valve does not require any greater difference in pressure to operate it than a small one, and is, therefore, desirable, but its inertia is usually greater, and in order to operate it sufficiently rapidly, it may be necessary to limit the lift to such a small amount that the flow is throttled, and may not be any greater than that obtained from the use of a smaller valve having a greater lift. A ball-valve is comparatively heavy in relation to the size of port which it controls, and much inferior in this respect to a well-designed valve of the "wing," "mushroom" or disc type.

It may, however, be said that ball-valves have proved to be quite satisfactory, even in the smallest size of pumps, provided that they are suitably arranged. The pump shown in the drawing may be regarded as a fairly sound example of a single-acting plunger pump with ball valves, and it will be seen that the valves are arranged in the usual manner, directly above each other, both being in detachable housings, and with limited amount of lift. Each has a notched or "castellated" restricting stop placed above it, and these stops may, with advantage, be made capable of adjustment, the most positive arrangement being by the use of shims, or distance washers. It may be noted also that this pump has a hollow plunger, the object, of course, being to reduce its inertia, and a gland of liberal size is employed to ensure a good seal against leakage.



An example of a single-acting plunger feed pump

The most suitable packing for this purpose is cotton yarn, impregnated with tallow. The most suitable materials for the pump construction are gunmetal for the body, gland and valve housings, and stainless-steel for the plunger and ball-valves. If any other type of valve is used, it should be of the same material.

Flash-steam plants almost invariably have, in addition to the engine-driven pump, a hand feed-pump for use when starting up, and in many cases, the hand pump is combined with the engine-driven pump, often using a single valve chamber and valves, with some method of locking the hand-pump lever at the end of its delivery stroke when it is not in use.

Valveless Feed-pumps

Despite the fact that the orthodox type of feed-pump, as shown above, can be made to work with reasonable reliability under normal conditions, it is a fact that when troubles arise with these pumps, the valves are usually to blame, and where marine steam plants are fed with water from a pond, fouling by means of mud, grit or organic matter, is by no means uncommon. It is generally recognised that elimination of the valves in a feed-pump would be desirable if it could be done without affecting the efficiency of the pump as a whole. In some cases, mechanically-operated valves have been used successfully in small pumps, but most constructors consider that the extra complication which they entail is undesirable. There remains the possibility of using pumps which are valveless, in the sense that they do not entail the need for any additional working parts in the pump.

The simplest pump of this type is the oscillating pump, which is an inversion of the simple oscillating steam engine. Such pumps have been used with great success for lubricating purposes where they operate in a viscous medium, which tends to seal any slight leakage of the plunger or valve face, but they do not work under quite such good conditions when pumping water, and have been relatively little used for this purpose. It is, however, possible by attention to details of design and accurate construction, to produce quite a satisfactory oscillating feed-pump.

(*To be continued*)

Slide-rest Control Modification

(*Continued from page* 441)

which were not worth the trouble of making.

Briefly, the method was as follows :—With an ordinary countersink of 60 deg., the hole was countersunk in the slide, a gunmetal collar turned to drive on the existing screw, and pinned into position as required. The taper of the collar was ground into the recess in slide, and finished with metal polishing paste, until a really smooth "feel" was obtained.

The drawing fully explains all the other needed parts, which can no doubt be found in the "junk" box.

The dimensions of the various parts will be to suit the particular lathe concerned.

Before trying to cure backlash in the locating method, one should make sure there is no slackness between screw and nut, and if wear has taken place, a new screw is very easily made.

IN THE WORKSHOP

by "Duplex"

47 – Fitting Angular Rests and a Twist Drill Jig to ■ Grinding Machine

COMMERCIAL undertakings find it profitable to grind lathe and shaping machine tools by ■ method that ensures constant accuracy of all the angles at the tool's point. This is achieved by the employment of grinding fixtures or jigs which enable the tools to be presented to the grinding wheel at an exact predetermined angle.

Although many workers are content to grind tools by the free-hand method and to estimate by eye the angles formed, this practice, when followed by those of limited experience and skill, will inevitably lead to faulty grinding and inefficient performance on the part of the tool. Consider for ■ moment the question of grinding correctly a small parting tool of the form shown in Fig. 1. Although there should be little difficulty in grinding the front clearance angle (A) correctly, this is not so when the side clearances (B) have to be formed; for not only has this clearance to be restricted to some 2 or 3 deg. in order to maintain the tool's strength, but at the same time it is customary to provide relief angles (C) of 1 deg. or so to ensure that the tool does not bind in the cut.

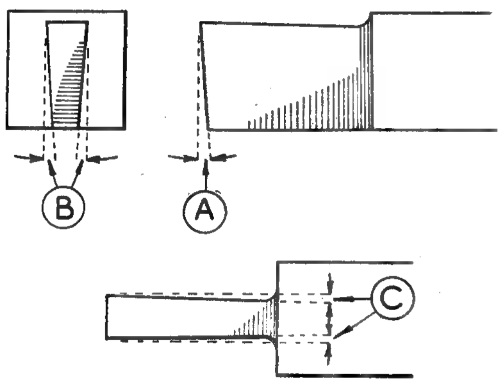


Fig. 1. The formation of a small parting tool

These requirements clearly demand great dexterity and a nicety of visual discrimination such ■ few ordinary workers can hope to command. If, however, the tool rest can be set so that the tool is automatically presented at the correct angle to the wheel to grind the side clearances, the operator is then relieved of one difficulty, and it only remains for him to guide the tool to grind the relief angle, which as seen from above is clearly in view throughout the operation.

When this method is adopted, the two finished side faces of the tool should appear as uniform flat surfaces. This means that the necessary side clearance has been ground with the minimum loss of material, and the strength of the tool is thereby preserved. On the other hand, when the sides of the tool are ground with ■ series of ridges, the clearance provided will be less effective and the tool may be greatly weakened.

Although, as has been seen, grinding ■ lathe tool successfully by the free-hand method presents many difficulties, this operation is usually easier than grinding ■ twist drill to the correct form. To grind by hand the conical point of the drill, with the proper clearance or back-off at the cutting lips, requires hand movements applied in three planes in space and, moreover, these must be exactly controlled. To appreciate the character of the motion required, roll the tip of ■ large drill on the surface plate while maintain-

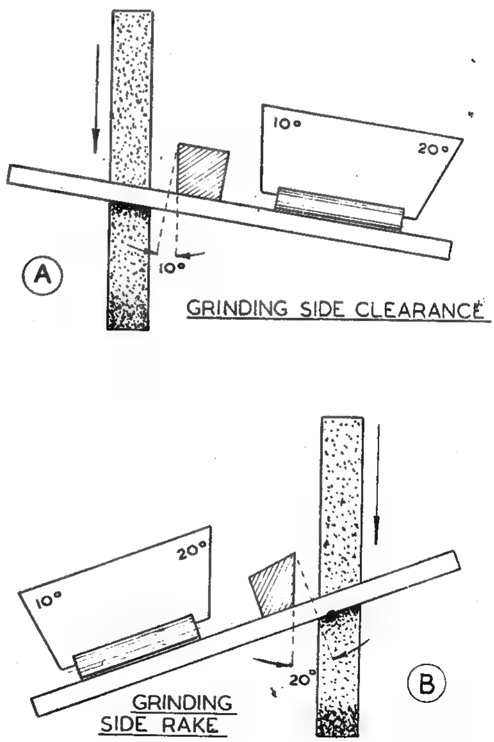


Fig. 2. Showing the method of setting the grinding rest

ing continuous contact from the cutting edge to the hinder part of the lip; then repeat this procedure on the revolving grinding wheel. If the grinding marks show that even contact has been maintained throughout, so far so good; but now try grinding a small drill of, say, 3/32 in. diameter. In the latter case, even an extremely delicate sense of touch will hardly enable the operator to guide the drill correctly while keeping its point in light but even contact with the wheel. Even when one cutting lip has been correctly ground, the other still remains to be similarly formed; furthermore, both lips must be ground to exactly the same axial height.

With a view, therefore, to enabling the worker possessed of moderate skill to grind lathe tools and twist drills quickly and accurately, the Wolf electric grinding machine illustrated in the accompanying photographs has been equipped with an interchangeable angular grinding rest and a Potts drill grinding jig, whilst at the left-hand end of the machine an angular rest is fitted to the coarse wheel for rough grinding operations.

Using the Angular Rest

The process of grinding a right-hand knife tool, having a side clearance of 10 deg. and a side rake of 20 deg., will serve as an example of how to use the grinding rest. At the same time, it should be borne in mind that the grinding wheel must always run towards and not away from the tool's cutting edge.

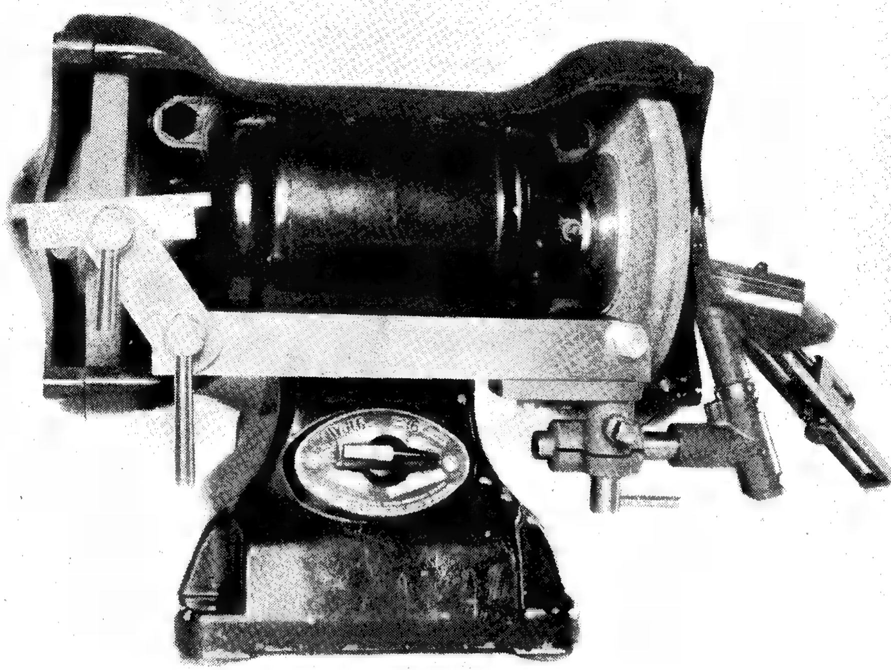


Fig. 3. The grinding machine fitted with twist drill jig and angular grinding rest

To grind the side clearance angle, the rest is set as shown in Fig. 2A, and the tool is applied to the right-hand side of the wheel; but when forming the side rake, as represented in Fig. 2B, the left side of the wheel is used so that its direction of rotation is still towards the tool's cutting edge.

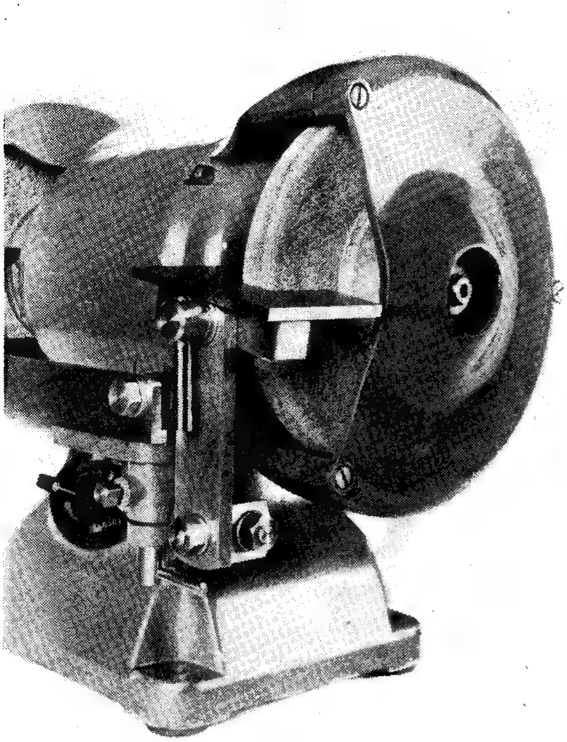
The rest can be readily set to any required angle by means of a template or gauge made of sheet metal or plastic material; and, in order to maintain the gauge upright, the lower edge may be bent to a right-angle, or a piece of angle strip can be attached to the gauge to serve as a foot. An alternative method of mounting the gauge is to slide it into a small clip or rule holder, such as that made by Messrs. Starrett; this will allow the gauge to be reversed for use on either side of the grinding wheel.

It will save time if a set of these gauges is made to cover the range of rake and clearance angles used, and, to afford ready identification, the gauges should be marked with their angular values. It will be appreciated that, as the flat surface of the wheel is used for grinding the tool, the exact height of the rest in relation to the wheel centre is immaterial.

Using the Twist Drill Jig

As already described, this jig can be used in place of the angular rest fitted to the finishing wheel at the right-hand end of the machine.

The correct amount of back-off is automatically



given to the cutting lips by setting the caliper jaws of the attachment to the shank of the drill being ground; next, the drill carrier is brought into its correct working position, close to the wheel, by sliding the jig as a whole in its bracket mounting. If a piece of sheet brass, some 5 thousandths of an inch in thickness, is held between the side of the wheel and the lip guide on the jig to act as a setting gauge, this adjustment can be readily made and will, moreover, ensure that the wheel does not foul and thereby damage the jig.

The angle of back-off can be varied at will, to suit special circumstances, by altering the setting of the caliper jaws; when grinding the points of centre-drills, this setting should be determined experimentally and then noted for future reference. Where a drill becomes heated during the grinding operation, do not dip it into water to cool the point, for this may lead to the formation of surface cracks in the cutting edges. Only light cuts should be taken, but if the drill point has been badly damaged, it is better to restore it approximately to shape by free-hand grinding on the periphery of the wheel, thus reserving the side face of the wheel for more exact work.

Left—Fig. 4. Showing the drill jig replaced by the angular grinding rest

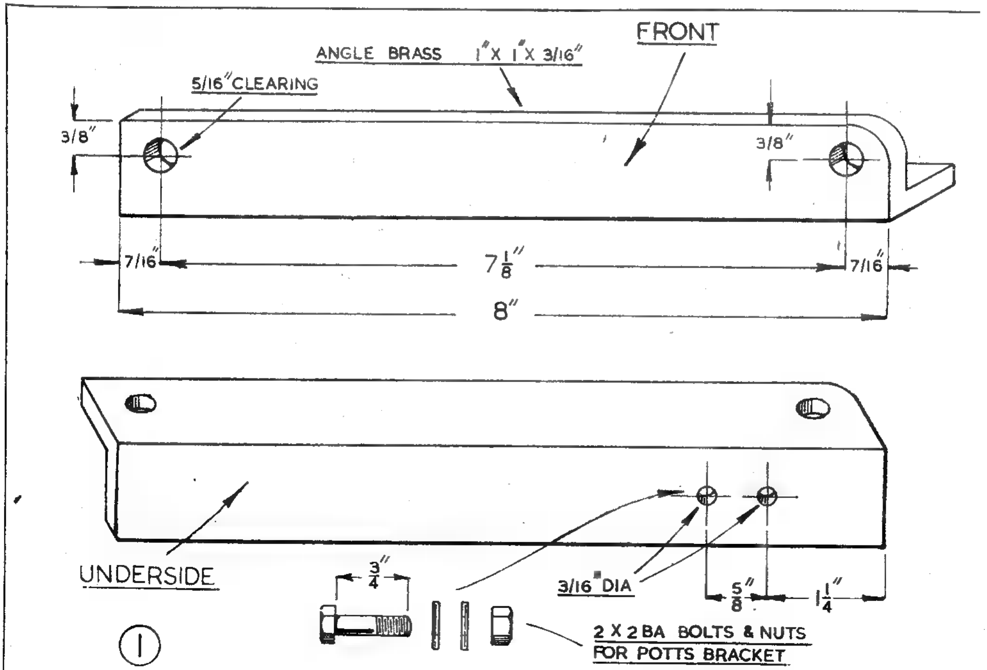


Fig. 5. The angle-brass mounting bar

Fitting the Potts Drill Jig to the Machine

As will be seen in the photographs, both the drill jig and the angular grinding rests are carried on a length of angle material attached to the machine. Commercial angle-iron, besides having a rough surface, seems seldom to be made to an exact right-angle, and, as the limbs usually taper in thickness, this material does not as a rule afford a satisfactory mounting if true alignment of the parts is required. Nevertheless, it is sometimes possible to obtain bright mild-steel angle which is of superior quality and of true formation.

On the other hand, commercial brass angle is more accurately made and will be found suitable for the present purpose.

The two hexagon rods which carry the grinding rests in the standard machine are removed and, when mounted in the self-centring chuck, one end of each is drilled 17/64 in. and then tapped $\frac{5}{16}$ in. to receive the attachment screws.

The brass angle is cut, filed and drilled to the dimensions given in Fig. 5, and finally it is brought to a good finish by draw-filing with a smooth file. The finished part can now be attached to the machine by means of two hexagon-headed screws, but the left-hand screw is only a temporary fitting, as it is later replaced by the special screw securing the rest in position.

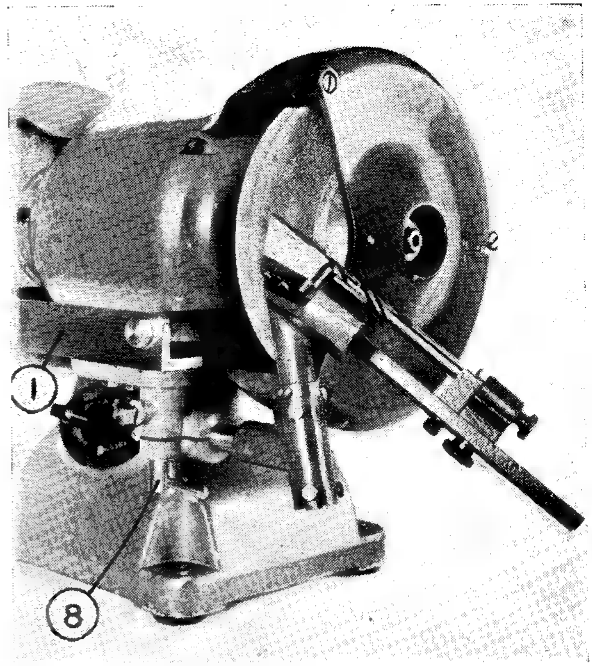


Fig. 6. Showing the method of attaching the drilling jig bracket

If a commercial hexagon bolt is used as a permanent fitting, its head should be machined for the sake of appearance. The screw is gripped in the self-centring chuck and a facing cut is taken across the head; this is followed by a chamfering cut at the standard angle of 40 deg. The back tool post will be found especially useful for this work, as the standard chamfering tool fitted can also be used to take the facing cut. The screw is finished by filing the flats with a fine file plied in the direction of the long axis of the bolt. Although these details may seem unimportant, as in fact they are for the efficient working of the machine, they do, nevertheless, add greatly to the appearance of the finished work.

What has been said concerning bolt-heads applies equally to nuts and washers, and where the latter appear to be roughly finished, it is an easy matter to make a stock of machined washers by drilling a length of rod gripped in the chuck and then using the two tools mounted in the back tool post for the facing, chamfering and parting-off operations.

The next step, as illustrated in Fig. 6, is to attach the standard bracket for carrying the drilling jig to the angle bar, and for this purpose two 2 B.A. hexagon-headed bolts are used.

As will be apparent in the photographs and will be described later, the handles for locking the rests in position are made of tapered form, otherwise they would look unsightly; for the sake of uniformity, therefore, the handle of the nut securing the drilling jig is also made to this pattern.

The dimensions of this nut are given in Fig. 7, and it will be seen that, here, a taper pin is used for the handle which is fitted into a corresponding taper formed in the nut by means of a taper pin reamer.

This handle can be given a good finish by gripping it in the chuck of the high-speed drilling

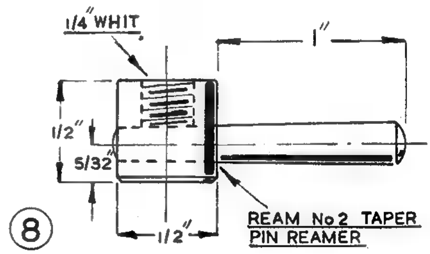


Fig. 7. Potts bracket lock lever

machine and then applying a strip of worn abrasive cloth; a little oil used on the cloth will help to form a smooth matt surface which is usually to be preferred to a highly polished finish.

It is, of course, important that the handle when tightened on the bracket should assume a position convenient for easy operation. This can be adjusted either by turning a small amount off the

(*Continued on page* 454)

A $3\frac{1}{2}$-in. Gauge L.M.S. Class 5 Loco.

by "L.B.S.C."

WE now come to the last chapter in the tale about " Doris " ; and though she doesn't get married and live happily ever after, as most heroines do, I have more than a suspicion that she has brought a meed of happiness to the good folk who have followed out the instructions, and will continue to be a source of pleasure all through her working life, which should be long, and trouble-free. Although the tender hand brake is not essential, and makes no difference to the working of the engine, the wheels of the $3\frac{1}{2}$-in. gauge tender look rather bare without the brake gear ; and the accompanying illustrations give the shape and dimensions of the necessary fitments. There is no need to go over the whole complete rigmarole, as the making of the parts, and their erection, are carried out precisely as recently described for the " Maid of Kent " and the " Minx," the only difference being that the parts for the $3\frac{1}{2}$-in. gauge engine are naturally smaller. If, therefore, I briefly run through the description, it should enable builders of " Doris " to complete the job easily and satisfactorily, in the minimum of time.

Brake Blocks and Hangers

The brake blocks can be either made up from castings, or cut from $\frac{3}{8}$-in. by $\frac{1}{4}$-in. steel bar, as described for the " Maid." Red fibre can be used by those who prefer it. Several readers ask if there is any objection to using brake blocks cast in brass or gunmetal, saying that these should have no ill-effects on the wheel treads. No objection at all ; as I said about fibre blocks, they can be painted, but they are partly obscured by the frames, and not noticeable even if left bare. Besides, non-ferrous blocks would rapidly discolour, and take on the " rusty " appearance which characterises " Doris's " big sisters since the railways developed the economy stunt. It will be noticed that the blocks are very small, but they are correct in size for the type of engine and tender.

The hangers are filed up from $\frac{1}{4}$-in. by $\frac{1}{8}$-in. steel. Note, the holes in the hangers are drilled No. 30, and the holes in the brake blocks No. 32. The hanger pins are plain turning jobs, the material needed being just a bit of $\frac{1}{4}$-in. round mild-steel held in three-jaw. Tip for beginners : when reducing the hanger end for screwing, turn it so that the hanger just slips on without shake ; then leave the hanger on, and turn the 3/32-in. part for the screw, letting the turning tool go as close as possible to the hanger without actually touching it. Remove hanger, and screw right up to the shoulder with the die in the tailstock holder ; you'll then be able to screw up the nut quite tightly without pinching the hanger, and at the same time the hanger won't have a chance to do any side-stepping. Another tip for the same fraternity—when pinning the brake blocks to the hangers, leave them stiff ; not a fixture, but just enough to " stay put " in whatever position you put them with your fingers. The blocks, when erected, will not rub against the wheels all the time, as they would do if left free to flop about.

Brake Beams

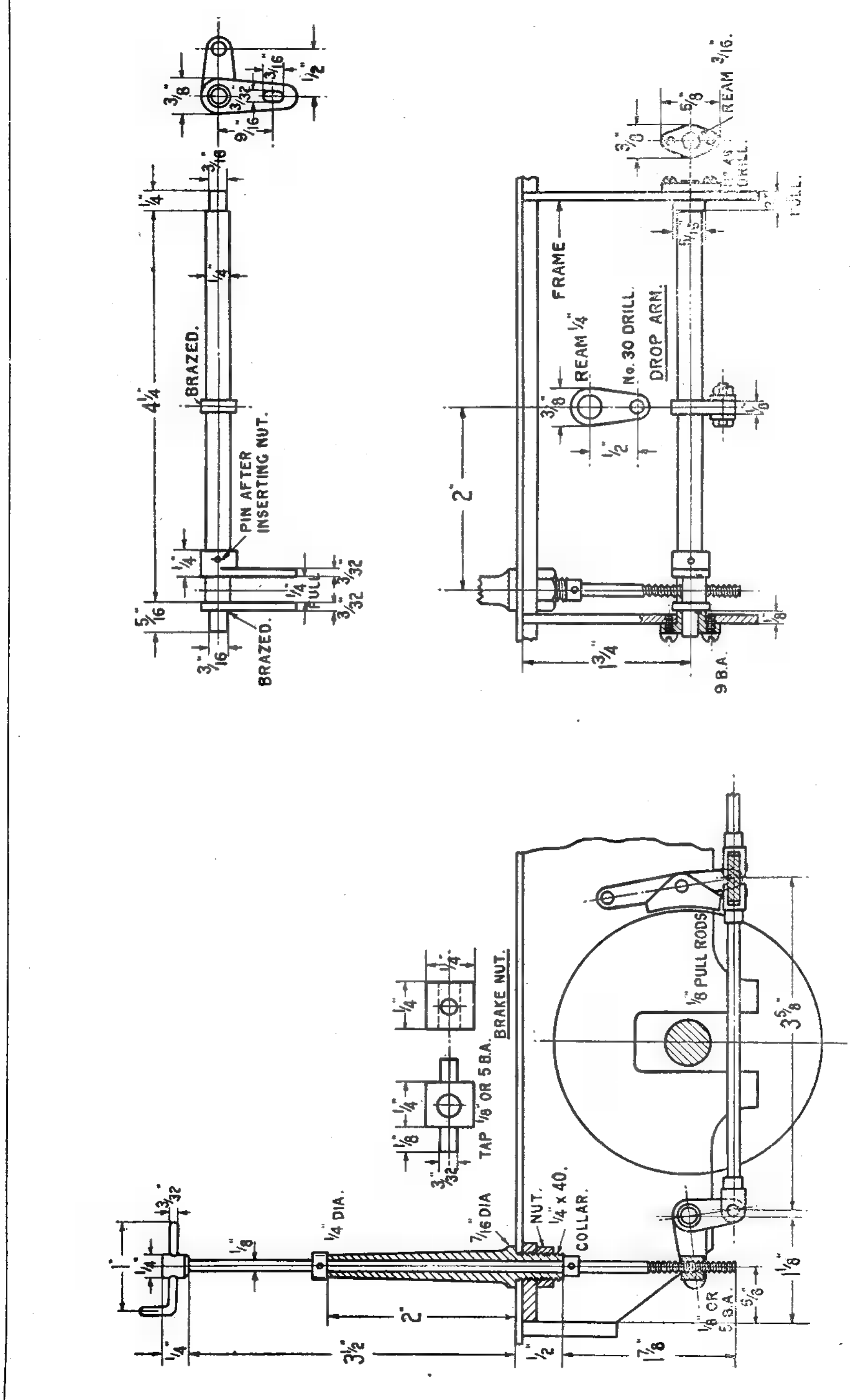
The beams are of the usual flat type, tapered off at each end. They are filed out of $\frac{1}{8}$-in. by $\frac{1}{2}$-in. steel, three pieces being needed, each $4\frac{5}{16}$ in. long. Chuck truly in four-jaw, face the ends, and turn down a full $\frac{1}{4}$ in. of each end to $\frac{1}{8}$ in. diameter, further reducing a bare $\frac{1}{8}$ in. to 3/32 in., and screwing 3/32 in. or 7-B.A. Two of the beams are drilled as shown ; the third only needs one hole in it. All three beams can be filed or milled to shape at one fell swoop, by clamping them together in bench vice or machine vice. Hangers (with brake blocks attached) together with beams, can then be erected as described for " Maid " and " Minx," using ordinary commercial nuts on the screws.

Brake Column and Shaft

The brake column requires a piece of $\frac{7}{16}$-in. round brass rod $2\frac{1}{2}$ in. long. Chuck in three-jaw, face the end, centre and drill No. 30 halfway through ; reverse in chuck, and repeat operation, letting the drilled holes meet. Turn down $\frac{1}{2}$ in. of the end to $\frac{1}{4}$ in. diameter, screw $\frac{1}{4}$ in. by 40, and face off any burring. Re-chuck in a tapped bush held in three-jaw ; bring up the tailstock centre to support the free end, and turn the outside to a taper as shown. Make a $\frac{1}{4}$-in. by 40 nut from a bit of $\frac{3}{8}$-in. hexagon brass rod, to fit the screwed part ; another kiddy's practice job needing no detailing.

The brake spindle is a 6-in. length of $\frac{1}{8}$-in. silver-steel or rustless steel. Put an inch of $\frac{1}{8}$-in. or 5-B.A. thread on the lower end. Make two little brass collars 7/32 in. diameter and about $\frac{3}{16}$ in. wide, drilled No. 32. Press one of these on the plain end, pushing it down the spindle until the top of it is $1\frac{7}{8}$ in. from the bottom of the screwed part ; then pin it with a bit of 16-gauge wire. Poke the plain end through the column, from the threaded end of same ; press on the other collar, so that it bears on top of the column, allowing the spindle to turn freely without end-play, and pin that also. Fit a handle to the top, same as described for the handle of the injector water valve, to enable the fireman to do his daily dozen.

At 2 in. from the centre-line of the tender, and to your left when you are looking at the front end of it, drill a $\frac{1}{4}$-in. clearing hole at $\frac{3}{4}$ in. behind the edge of the drag beam ; approximately $\frac{7}{8}$ in. from the edge of the soleplate. This hole goes clean through soleplate and top member of the beam, as shown in the illustration. Put the screwed end of the brake column through it, and secure it with the special nut.



Tender brakes for "Doris"

The brake shaft is a piece of $\frac{1}{4}$-in. round mild-steel $4\frac{13}{16}$ in. long. Turn $\frac{1}{4}$ in. of one end, and $\frac{5}{16}$ in. of the other end, to $\frac{3}{16}$ in. diameter. File up the drop arm from $\frac{1}{8}$-in. by $\frac{3}{8}$-in. steel; I usually make these oddments from bits left over after cutting out frames. Drill and ream as shown, and squeeze it on to the shaft midway between shoulder. Next, file up the two brake arms from 3/32-in. flat steel. The smaller end has a slotted hole 3/32 in. full wide, and $\frac{3}{16}$ in. long; simply drill two No. 40 holes close together and run them into a slot with a rat-tail file or an Abrafile. Drill both the larger ends with No. 14 drill; ream one of them $\frac{3}{16}$ in., but only put the reamer in far enough to make the hole a very tight fit on the end of the brake shaft. Chuck a bit of $\frac{3}{8}$-in. round steel rod in three-jaw, and turn a pip on the other end to a tight fit in the hole in the other arm. Part off $\frac{1}{4}$ in. from the end, squeeze the pip into the hole in the arm, and braze or silver-solder it. Chuck the boss in the three-jaw, and drill letter "C" or 15/64 in., reaming $\frac{1}{4}$ in. to fit the shaft. After cleaning it up, slide it on the shaft, boss first; don't forget it goes on the end with the longer spigot. Then put the plain arm on, set it at right-angles to the drop arm, and braze both brake arm and drop arm at the same heat. Quench in water only, and clean up.

To make the nut, chuck a bit of bronze or gun-metal rod, $\frac{1}{4}$ in. square, in the four jaw. Set to run truly. Some folk, especially beginners, seem to have a dickens of a job to set square or rectangular stuff truly in the four-jaw, whilst actually it is only a matter of seconds. All your humble servant does, is to run up a pointed tool, such as an ordinary knife tool, to the rod, and adjust the jaws until the point scratches all four corners of the rod when the belt is pulled by hand. Face off the end with the knife-tool, then turn down $\frac{1}{8}$ in. length to 3/32 in. diameter. Part off at $\frac{3}{8}$ in. from the shoulder. Reverse in chuck, by slacking jaws Nos. 1 and 2, putting the embryo nut in, and re-tightening same. Turn another 3/32-in. spigot $\frac{1}{8}$ in. long, on the projecting end. Drill a No. 40 hole through the cube, tap $\frac{1}{8}$ in. or 5-B.A., and there is your nut. Put one of the trunnions through the slotted hole in the fixed brake arm; run up the movable one until the other trunnion enters the slot in it, leave the nut just free to turn, and pin the boss to the brake shaft by a piece of 16-gauge steel wire driven through a No. 52 hole drilled through boss and shaft.

How to Erect the Brake Shaft

At $1\frac{1}{8}$ in. from the front end of frames (that is, from back of drag-beam) and $\frac{1}{2}$ in. above the bottom edge at that particular point, drill a $\frac{5}{16}$-in. hole each side. Drill a No. 30 pilot hole each side first, and test with a bit of $\frac{1}{8}$-in. silver-steel through them, to see if they are exactly opposite. Then turn up a couple of flanged bushes from $\frac{3}{8}$-in. round rod; gunmetal or bronze for preference, though brass will do at a pinch. Chuck the rod in three-jaw, face, centre and drill No. 14. Turn down $\frac{3}{16}$ in. length to fit the $\frac{5}{16}$-in. hole, and part off to leave a 3/32-in. full diameter flange. Ditto repeato for bush No. 2, but this only needs to be $\frac{1}{8}$ in. long on the $\frac{5}{16}$-in. section. File the flanges oval, and drill each No. 48 as shown, for the fixing screws. Put a $\frac{3}{16}$-in. parallel reamer through each bush.

Temporarily remove the brake column, then put the brake shaft in place with the nut on the same side of the tender as the column; this is easily done, as the $\frac{5}{16}$-in. holes allow the shaft to be put in, plain end first, from the inside of frame. Hold it in position with the spigots in the middle of the $\frac{5}{16}$-in. holes. Slide the bushes over the spigots, the narrower one going next to the brake arms; then secure each bush with two 9-B.A. screws running through the No. 48 holes in the flanges, into 9-B.A. tapped holes in the frames. Locate, drill, and tap the holes as described for cylinder-cover screws. As you replace the brake column, run the screwed end of the spindle through the brake nut, as shown in the illustrations.

Connecting Up

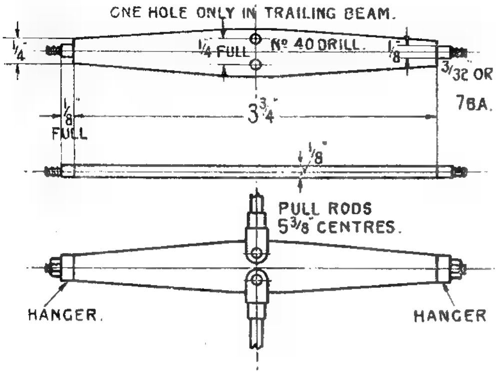
This is a simple job. Six forks or clevises are needed, made from $\frac{1}{4}$-in. square steel, to dimensions given in the drawing; they are made in the same way as described for valve-gear forks, so I need not repeat the details. The pull rods are made from $\frac{1}{8}$-in. round steel; mild, silver or rustless, doesn't matter which. The front one needs a piece approximately $3\frac{1}{2}$ in. long, and the others 5 in. Put a few threads on each end of each bit, to match the tapped bosses of the forks, and screw on the forks, so that the distance between eye centres on the first one, is $3\frac{7}{16}$ in., and on the other two, $5\frac{3}{8}$ in. The forks are attached to the drop arm, and the brake beams, by pieces of 3/32-in. silver-steel, screwed at both ends and furnished with ordinary commercial nuts. Note, the plain part between the nuts should be approximately 9/32 in. long, so that when the nuts are screwed up tightly to the ends of the threads, they don't pinch the forks, and so cause the brake gear to work stiffly. You should be able to turn the pins with your fingers after the nuts have been tightened. Small split-pins, as used for pinning castellated nuts in automobile work, could be used, if desired, in place of the nutted pins. As the brake gear is not used for service stops, they would be quite satisfactory; and in any event, can be renewed in a very few minutes.

Don't forget, after assembly, to "ile the jints," as one of my old footplate mates used to remark. Then, when the brake handle is turned clockwise, the blocks should touch all the wheels at once, with a perfectly smooth action. If one pair contacts before another, merely disconnect the fork from the beam, and screw or unscrew half a turn or so, as the case may be. It is merely a matter of easy adjustment, to get all the blocks to touch the wheel treads at the same time. There is not the slightest need to go to the trouble of making and fitting a full compensating gear, even if the brakes were intended for service stops; none of our Stroudley engines had any compensating gear, and we always managed to stop all right, the brake blocks wearing very evenly. Many modern engines have no compensating gear on their tender brakes; for example, the full-sized "Hielan' Lassies." No pull-off springs are needed, for the simple move-

ment of turning the brake handle anti-clockwise for a few turns, pushes the brake blocks clear of the wheels.

Epilogue

So we come to the end of the story. As with the "Maid" and "Minx," if builders wish to add all the little blobs, gadgets, decorations and what-have-you, as carried by "Doris's" full-



Brake beams

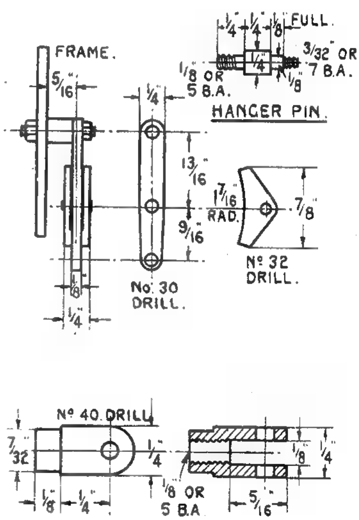
sized relations, they can get close-up photos from any publishers of locomotive pictures or literature, and let themselves go to their hearts' content. Perhaps even our good friend Mr. Hambleton might care to give details of a few embellishments, for those who desire them; though I'm afraid his sympathies, like my own, are along with the old-timers! As regards painting, the full-sized engines are black, and the little one could be painted with any good heat-resisting enamel, such as used for domestic radiators, baths, and hot-water cans. For the benefit of beginners, here is how I get the paint on my boilers, to stand the working temperature without blistering. The engine is first thoroughly cleaned with petrol—it takes very little—a job which is done in the open air. The boiler is filled nearly full of warm water, and the paint (enamel, or synthetic hard gloss) applied with a camel-hair or sable brush, as used by water-colour artists. I don't use any undercoating; if the metal shows through, a second coat applied after the first is dry, is all that is necessary. After being painted, the boiler is kept just below boiling point, by a small home-made Bunsen burner in the firebox, for about twelve hours all told. This need not be continuous. The engine is placed somewhere where there isn't much dust flying around, and the boiler is covered by a sort of tunnel made of stout brown paper. This treatment never fails to "set" the paint or enamel, making it impervious to oil spots, or drops of hot water. If sprayed with oil or water, a few rubs with a soft cloth, or piece of cotton waste, makes it shine, or "bobby-dazzle" as the cleaner-boys used to say. Engine-cleaning can now be classed among the lost arts; the race who practised it, is extinct. Old-timers among our readers who recollect the Brighton engines, the S.E. & C. R. engines of Harry Wainwright, the G.W.R. single-wheelers, and others around the turn of the century, resplendent in shining paint, gleaming brass and copper, and bright steel, will mournfully agree. Such is the state of things to which "money-grubbing," under the fancy names of "rationalisation" (not to mention "nationalisation!") "economics" and so on, has brought one of the greatest benefactors of mankind; incidentally the *only* one that has never been used for purposes of bloodshed and destruction.

Parts of the engine not subjected to heat, can be painted in the usual manner; and if left to dry in air for a day or so, according to the kind of paint or enamel used, will set hard enough for ordinary use. After running an engine, never put her away dirty; drop the fire, and wipe all the superfluous oil and dirt off whilst she is still hot; she will then keep her "new look" for a surprisingly long time.

As promised, I have a short story to tell about a weeny sister to "Doris"; and all being well, and our friend the K.B.P. having no objection, will tell it after we have given the builders of "Tich" a little more information about axle and eccentric turning.

Vision—or Prophecy?

My little bit of "crystal-gazing," as recounted for your amusement in the issue of July 14th last,



Details of brake gear

has had a rather startling sequel, for nearly every correspondent (and they are many) who has referred to it in his letters, has asked the question—how much really *was* "yarn," and how much was actually "advance information"? Well, the only answer I can give to that, is that those who live longest will see most! Others want to know if the locomotives described by their drivers, Bill and Jock, could actually be built

and operated thus; and if so, what about describing $3\frac{1}{2}$-in. gauge editions of them, so that "coming events could cast their shadows before," in a manner of speaking.

Well, I'll tell you something that I don't "blow off" about, but what is honest gospel truth. Though I have laid bare, many of the "secrets of success" in these notes, and practically every efficient little locomotive running today, has "a bit of old Curly" in its make-up (even though some owners and builders don't care to admit it!) there are some things I have *not* disclosed, even to my few personal friends; and at present I haven't any intention of doing so. Enginemen on the L.B. & S.C. Ry. always used to try to get a few minutes in hand, so that if delayed by a signal stop, a p-way check, or any other untoward happening, we could still arrive "right on the dot." It is still the same with your humble servant; I always reckon to keep enough "up my sleeve," to enable me to keep a few block sections ahead of anybody who thinks they "know all the answers." I don't know all of them, but I try to learn, by experiment, as many as I possibly can. The few good folk who have seen and driven my own locomotives, often ask about "the little bit of something that the others haven't got," inside the steam chests and hidden in the valve gear.

I have actually tried both the systems mentioned in the "vision of the future," and they both work perfectly. I have incorporated the "Chapelon" part of the L.N.W.R. engine in my "Jeanie Deans." Bill, in the story, said that with 250 lb. in his boiler, the expansion was so perfect that you couldn't hear the exhaust. My "Jeanie" is the same; with 90 lb. on the boiler gauge, she runs silently, with a load equal to 320 tons behind the tender. That is using steam instead of wasting it, if you like! Compare it with the engines seen working on club and exhibition tracks—'nuff sed. The idea of cutting out the main steam supply to one pair of cylinders on a four-cylinder engine with the 135 deg. crank setting, was put forward by Mr. Holcroft himself, many years ago. It works all right in the small size, the power of four big cylinders at starting, giving an acceleration on dry or sanded rails, equal to any electric outfit, and allowing grades to be taken at high speed, exactly as Jock described. Once the speed is attained, the outside cylinders (as big as those of a normal two-cylinder engine) have no difficulty in maintaining it with a very early cut-off. The system really boils down to applying a pair of booster cylinders to the coupled wheels, instead of a separate axle. I originally intended to fit the cut-out valve on "Tugboat Annie"; but she is so economical of steam, when properly handled, that I never bothered about spending the extra time on it. Time is my biggest enemy these days!

Some of our readers were so tickled with the story that they are asking for more, on the same lines—literally! Well, this is a technical journal, not a story magazine; but if our worthy friend who wields the blue pencil (though he is kind to my notes!) raises no objection, I might look into the crystal again, and see what we have on the south side of the Thames, at about the same period. See, for instance, what sort of a locomotive is pulling the Cornish Riviera express—we already know her name and number, 111 "The Great Bear"; and what kind of engine it takes to run from Victoria to Dover with twelve "Golden Arrow" Pullman cars in the level hour. Did I hear somebody murmur "Southern for Sunshine—and for Speed?" Ah, well—you know that famous saying by a long-departed politician—"Wait and see"!

In the Workshop

(*Continued from page* 449)

abutment face of the nut, or by using a washer of the correct thickness. When facing-down the nut, calculate the amount to be removed by estimating what fraction of a circle the nut has to turn to bring it into the correct position; this will likewise represent a fraction of the thread pitch, in this case 50 thousandths of an inch. If, therefore, the nut is required to turn an additional 1/5 of a revolution, then 10 thousandths must be turned off. Should, however, a selection of washers be available, it may then be possible to find one which when fitted brings the handle into the required position. Failing this, a feeler gauge may be used to determine the exact thickness of the washer needed.

What has been said in connection with the present handled-nut will also apply later when the locking handles are fitted to the grinding rests.

Readers may wonder what is the purpose of the four set-screws, seen in Fig. 6, fitted to the bearing bracket of the main pivot of the drilling jig. These screws were fitted to take up any play that might develop in the bearing and, at the same time, to impose a light frictional control during the operation of the jig.

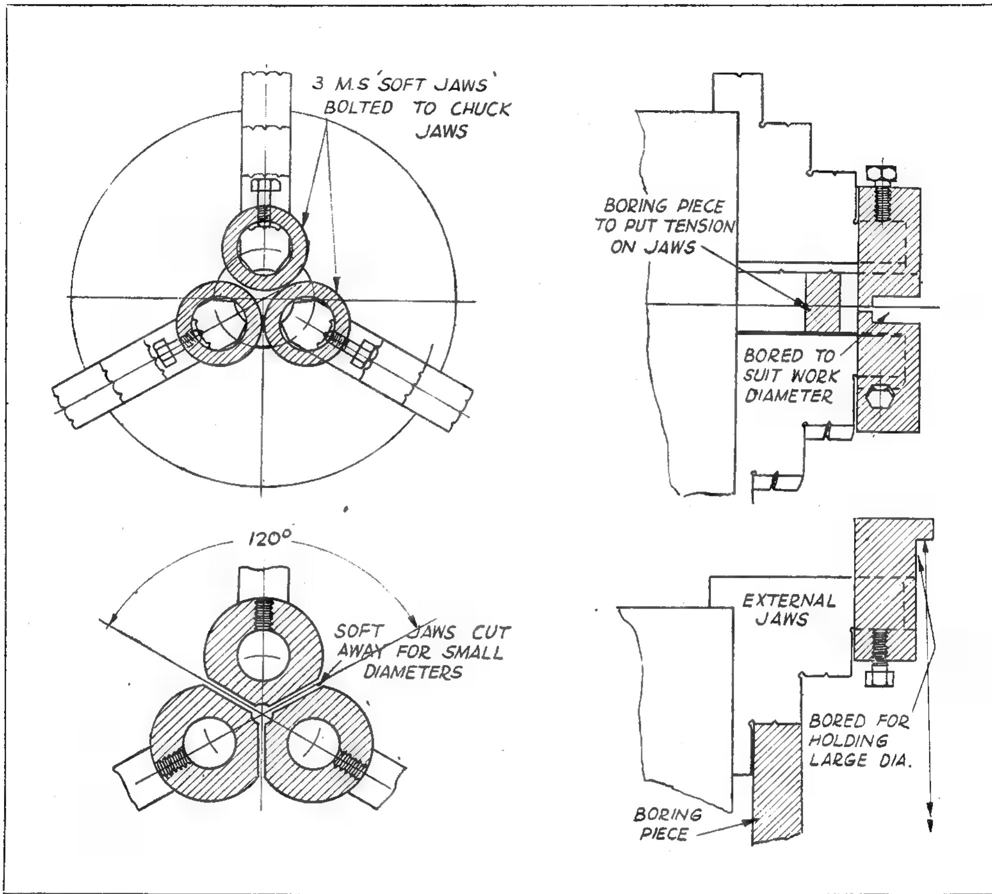
The screws, which are fitted with lock-nuts, are of $\frac{3}{16}$ in. diameter and 40 t.p.i., whilst, to ensure smooth working, fibre pads are fitted between the ends of the screws and the spindle.

In larger and more elaborate commercial grinding jigs, spring-loaded coned bearings are sometimes used to prevent play developing when wear takes place.

(*To be continued*)

Fitting Soft Jaws to a Chuck

by H. J. Gates



IN a recent issue of THE MODEL ENGINEER, there was an article by Mr. E. Trotter, for a device for truing up a three-jaw self-centring chuck, which prompted me to write the following description of an idea which I introduced into the small engineering firm where I work. This improvement has proved highly successful and timesaving, especially on repetition work.

It will be seen from the sketch that three mild-steel pieces are turned and bored a snug fit on square ends of the jaws. These pieces are drilled and tapped for a small bolt or Allen screw for clamping purposes.

A conveniently sized piece of metal is held firmly in the chuck behind the "soft jaws" which are then bored, preferably with a step, to the outside diameter of the work to be held. It will be found, upon removing the boring-piece from the chuck, that the work now held in the "soft jaws" will run exactly true.

This method may seem a little laborious, but is well worth the time and trouble where an absolutely "spot" job is required.

Various designs of jaws suggest themselves, as this method can be used on internal or external jaws and where strained or badly worn scrolls are encountered will be found a boon to model engineers who have no internal grinding attachment for carrying out the truing-up method suggested by Mr. Trotter.

This method, by using the external jaws, is also useful as a means of holding larger diameters than the chuck is really made for, but it is not highly commended in view of the further strain on the chuck.

The Swiss International Regatta

by Geo. H. Stone

THE Swiss International Regatta for the Hispano-Suiza Trophy was held at Geneva on August 21st under the most pleasant and friendly conditions, and attracted all the experts from the Model Racer Club, Geneva, and the Model Yacht Club, of Paris, including Gems Suzor, Robert Jonet and Maurice Mahieu.

The Model Racer Club, of Geneva, have a nice stretch of water, complete with covered stand and accommodation for judges or timekeepers.

After staying in Paris with that well respected pioneer, Gems Suzor, I had my first introduction to the Swiss competitors at the house of their president, Jean-Louis Chevrot, at a party given in honour of my wife and myself. They were very interested in my two twin boats, *Lady Babs II* and *Rodney*, and were intrigued with the glass-like finish of the models. This has been obtained with the help and advice of Mr. Minnis, of Messrs. Phenoglaze, who has supplied me with a nitro-methane proof finish that can be applied with a brush, the number of coats and the amount of rubbing down being the criterion of the final surface.

On the Friday preceding the Regatta, some of the Swiss and French competitors and myself had some trials, *Lady Babs II* doing 74.5 m.p.h. and *Rodney* doing 68.3 m.p.h. over 500 metres.

The day of the International event turned out to be a real scorcher, and a lot of trouble was experienced in getting the engines to perform at all well; in the morning I was unable to get *Lady Babs II* away, and at lunch time was taking 2nd place with *Rodney*, Pierre Chevrot, with his *Be-Bop II*, leading me by 2 km. per hr. After a non-austerity lunch provided by the Geneva club, I got *Lady Babs II* away on a smaller propeller, clocking 65 m.p.h.; this run enabled me to get a check on the needle setting, and on my last run a speed of 68.21 was recorded to win the event, *Rodney* taking 4th place with a speed of 58.7 m.p.h.

Competition was very keen, 20 boats being entered for the 10 c.c. event, a speed of 50.8 m.p.h. being only good enough to give Robert Jonet, of France, 8th place.

In the 30 c.c. event, Maurice Mahieu won, with a speed of 48.6 m.p.h., against Gems Suzor, 47.1 m.p.h.

After the meeting, I set up a new European record over 500 metres, of 70.8 m.p.h., and on my final run was travelling far in excess of this speed when my thrust bearing siezed up.

Mr. Stone with his "C" class boat, "Lady Babs II"

Most of the Continental competitors are using converted Hornet engines fitted with magnetos. They expressed great surprise at the speeds of my boats run on glow-plugs.

Another notable thing was the lightly-constructed propellers of small pitch used by them, in contrast to the heavy, large pitch, stainless-steel propellers made by me.

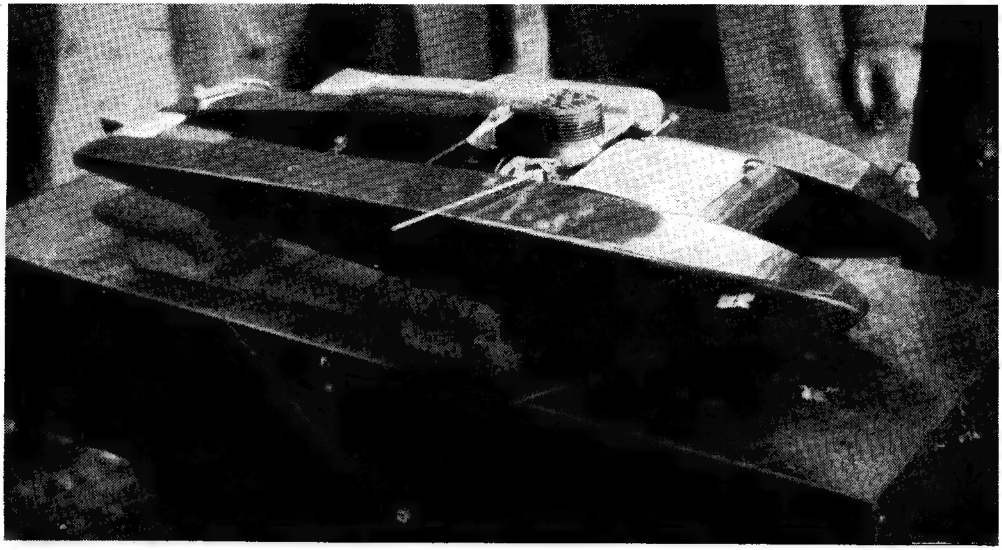
Their boats are built on similar lines to those shown in American books, and a great deal of experimental work has been carried out to reach the high standard I witnessed at Geneva.

Regarding the running of fast boats, it is obvious that ponds like Victoria Park are not suitable for high speeds, and running events such as the International on them does not give a true result. It may be said that it is the same for everybody, but this is not correct, as the conditions favour the slow boats.

As an example: At Victoria Park on May 22nd, my *Lady Babs II* would not stay on the surface at speed, and yet a few days later, after repairing the damage caused by hitting the bottom, a speed of 66.84 m.p.h. was recorded at Epsom.

On the Saturday before the International, I ran *Lady Babs II* at 61.5 m.p.h. with a silencer, but at Victoria Park I could not get a proper run. On the following Tuesday, having had special permission to use the yacht pond in one of the royal parks, I recorded a speed of 77.54 m.p.h. without a sign of capsizing.

It seems that if one wants to figure in events run on these ponds, a boat must be designed to run at speeds under 50 m.p.h., and a great deal of credit is due to those who run boats and keep the interest going. For my own part, I wanted



Mr. Stone's second boat, " Rodney "

to develop a boat to go as fast as the best of them ; in this, perhaps, I am a bit selfish.

However, there is no comparison between the regattas held here, with their rather drawn-out straight running events, and the speed event I was lucky to take part in at Geneva. It is a big problem, and my observations are in no way intended to belittle the magnificent efforts of those very able and keen promoters in this country (after all, I promoted the worst regatta held here this year).

Next year we will be host to the Swiss and French competitors, who are coming over in an endeavour to win back the Hispano-Suiza Trophy, and I feel that we ought to try to put on a show comparable to theirs, and beforehand try to standardise harness attachments and methods of running these speed events.

Regarding suitable water for running events, I have often heard that a certain pond would be O.K. if it was not so deep. In Switzerland and France they make use of a starting platform that can be raised and lowered ; this might well be adopted over here. At Geneva this year they were using, for the first time, electric timing gear with tape recording, constructed from drawings I sent of the Malden Club time recorder.

To conclude, the visit to Geneva was a success, and my reply to the toast given by the chairman sums up the spirit in which the event was run. " It is better to make friends than win prizes ; I have been lucky in doing both."

Result of 10 *c.c. Event*				m.p.h.
1st	George H. Stone	England	*Lady Babs II*	68.21
2nd	Jean-Louis Chevrot	Switzerland	*Folbrise V*	62.5
3rd	Pierre Chevro	,,	*Be-Bop II*	60.1
4th	George H. Stone	England	*Rodney*	58.7
Result of 30 *c.c. Event*				
1st	Maurice Mahieu	France	*Flying Pontoons*	48.6
2nd	Gems Suzor	,,	*Nickie VIII*	47.1

The " Midge "

Mr. C. R. H. Simpson, A.I.Loco.E. writes :—" My attention has been drawn to an article by Mr. K. N. Harris, in your issue for June 30th, wherein he refers to the 'Willoughby-Gentry design for the . . . Midge.'

" While I have no desire for kudos, in the interests of accuracy I would point out that the basic design of this engine was mine.

" Owing to pressure of other work I was unable to accept Mr. Percival Marshall's invitation to describe it—a task ably performed by my friend Mr. George Gentry. In addition, Mr. Willoughby—who had a profound knowledge of locomotives—elaborated various aspects of the proportions, etc. This does not, however, alter the fact that I was responsible for the general design, as may be easily confirmed by referring to page 42 of your Jan.-June 1935 volume."

Converting Hand Shaper to Power Drive

by A. S. Keep

THE No. 2 Adept Hand Shaper is a deservedly popular little machine and model engineers have increased its usefulness by adding various refinements which could not be included by the makers at the original selling price, but so far the writer has not seen any conversions to power drive.

As the arrangement described below has proved very satisfactory it may serve as a useful basis for others who find hand shaping of any considerable surface with a fine feed a lengthy business.

Most small hand shapers, including the Adept, differ from larger power driven machines in that the ram, in addition to the fore and aft stroke, is moved sideways to traverse the work, which remains stationary, while the usual practice for power machines is for the ram to have fore and aft motion only, the work being carried on a movable table traversing the stroke of the ram. This, of course, simplifies the application of power to the ram.

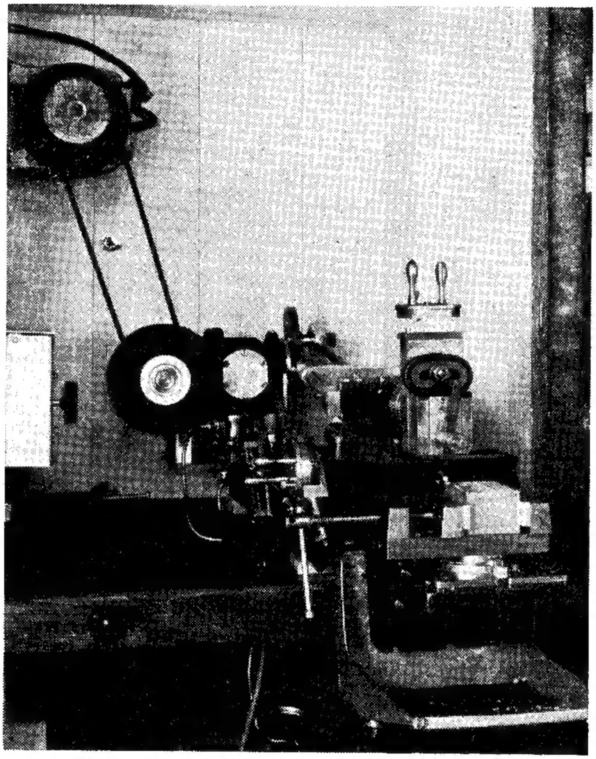


Photo No. 1. General assembly of shaper with motor and rheostat

The obvious way of driving the ram on the Adept was by some form of crank to give the necessary reciprocating motion, but to allow for the traversing, a universal joint had to be introduced realising that the crank and ram would only be working in the same plane in the mid position of the cross traverse, and, therefore, that certain side loads would be introduced.

To get smooth running and ease the load on the power stroke it was necessary to introduce a flywheel, and, as it was intended to drive by electric motor, the flywheel could be small, and running at high speed store up plenty of energy and use gearing between it and the crank.

Before attempting the conversion, scale line diagrams were made to see what the angularity of the thrust loads and the corresponding side loads on the slides of the ram were likely to be.

Taking a thrust load of 200 lb. on the power stroke, it was found that by using a connecting rod 18 in. long to transmit the power from the crank to the ram the side loads would be under 30 lb. with the ram in the extreme cross traverse position and the maximum offset of the connecting rod from the plane of the crank only six degrees.

These preliminary details have been gone into at some length in case any readers decide to make the conversion in some modified form.

The writer strongly recommends that the connecting rod should not be made less than 18 in. long or the side loads will be considerably increased, and also that a flywheel should be incorporated.

Photo No. 1 gives a general idea of the complete plant with 25 V motor drive and speed control rheostat mounted on the left side. The motor on full load takes eight amps, and has ample power.

The bed of the machine consists of two lengths of angle iron 2 in. × ¼ in. × 24½ in. long. The shaper is bolted at one end, and across the other end is a piece of ½-in. steel plate 6 in. wide by 12½ in. long. This carries the reduction gear and crank.

The reduction gear and casing were bought from the local scrap merchant and had been part of the retracting gear for an aircraft undercarriage. It is a 40 : 1 gear, and when bought had a 24 V motor for driving. The motor was useless for driving the shaper, being a very heavy duty type intended for short periods of running

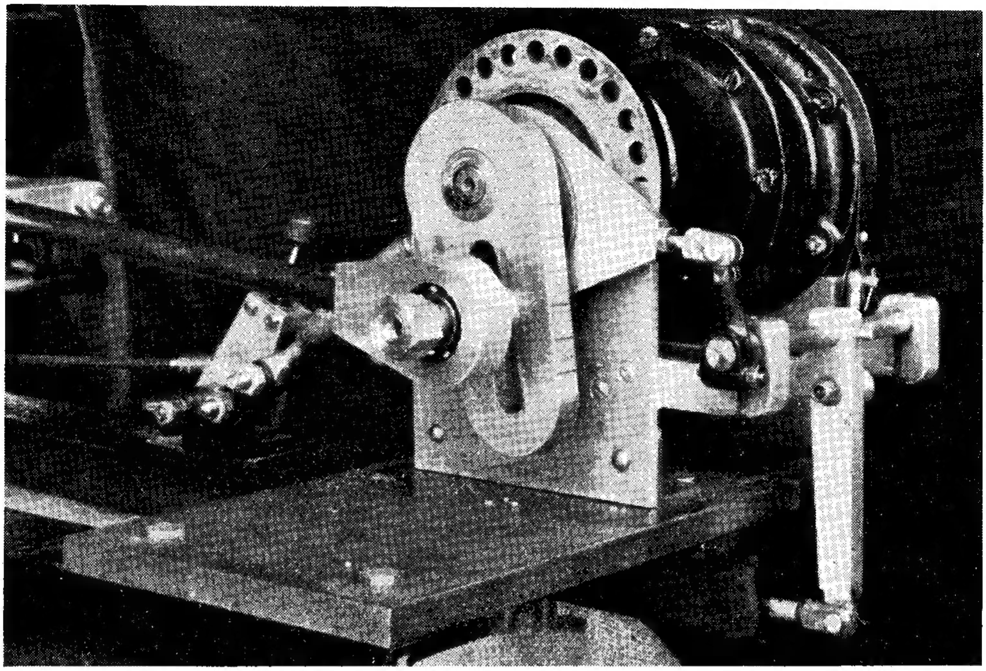


Photo No. 2. Slotted crank and eccentric gear

at high power. It was removed bodily and a new shaft turned to carry the bevel pinion on the end of the armature shaft and a new ball-bearing in a plate to replace where the end of the motor had been. On the outer end of the shaft a 6 in. diameter flywheel and pulley were fitted. The reduction gear also contains a plate clutch, which can be set to slip at a predetermined load. This is

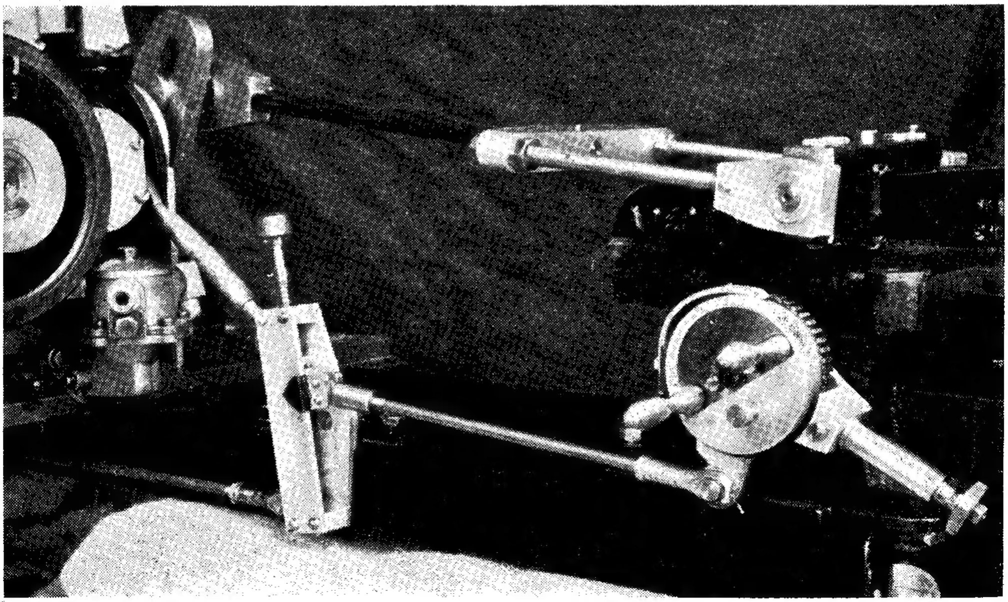


Photo No. 3. Automatic feed and crosshead

a very useful addition and prevents damage should too heavy a cut be attempted.

The crank web is cut out of ½ in. steel plate screwed on to a steel boss. The web has a ½ in. wide slot enabling the crankpin to be set at varying distances from the centre of the shaft giving a stroke anywhere between three and six inches. The stroke can be altered in a few seconds by slacking a nut on the crankpin projecting beyond the big-end, and the throw revolves clockwise, this ensures that on the power stroke the ram and cross traverse slide are pressed down on the bed and not lifted up.

Both the handwheels for the vertical feed for the cutting tool and the cross traverse are fitted with micrometer heads. These are aluminium alloy rings (turned out of old pistons) engraved, and can be locked in any position by means of a clamping plate and knurled knob which can be seen in the photograph.

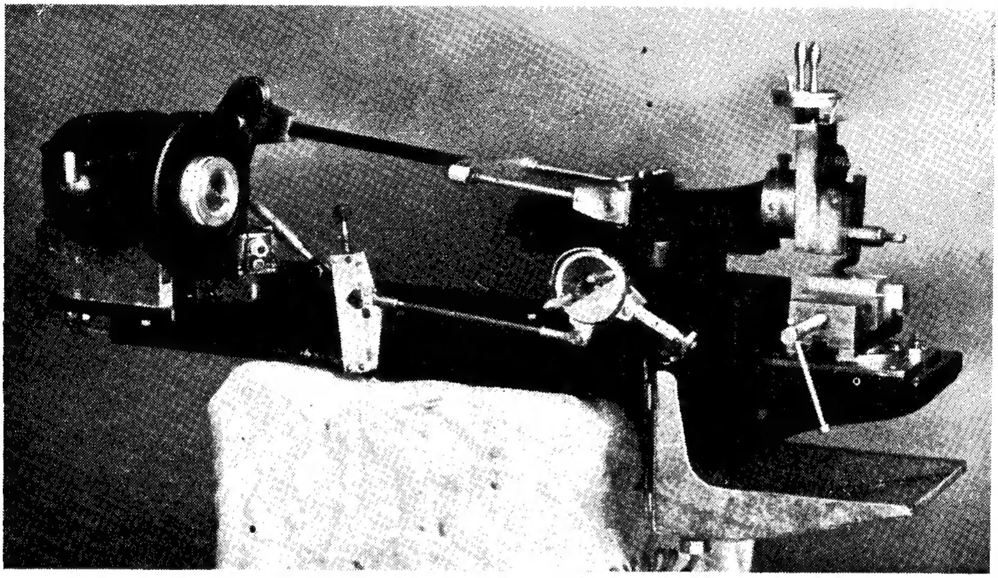


Photo No. 4. Side view of complete machine

can be seen in the photograph marked on the edge of the crank web (Photo No. 2).

On the boss of the crank behind the web is carried an eccentric of ⅞ in. throw. This operates a rocking shaft which works the automatic cross traverse and also a suds pump.

The big-end is cut out of ⅝-in. thick dural and carries a double row self aligning ball-bearing shrunk in. A spigot is forced into the tubular connecting rod and pinned.

At the other end of the connecting rod is the crosshead (Photo No. 3). This carries two ½ in. plain bearings of ⅝ in. dural working on trunnions. The hand operating lever supplied with the shaper was removed and replaced by the two trunnion shafts which are held between two flat steel bars with ¼-in. bolts in reamed holes.

Incidentally no alteration has been made to the shaper and if desired at any time the trunnion shaft can be removed and the hand lever replaced.

The height of the crankshaft above the bed is the same as the height of the trunnion bearings so that with the crankshaft horizontal, the connecting rod is also horizontal. As the crankshaft, looked at from the reduction gear end,

The vertical feedscrew is 16 t.p.i. and so the micrometer head is divided into 125 divisions which gives a ½ thou. feed for each division.

The traverse screw is 10 t.p.i., and the micrometer head is divided into 100 divisions giving one thou. feed per division.

The automatic cross traverse has worked in very compactly and gives a feed varied at will from two to twelve thou. per stroke.

The ratchet wheel was cut out of ⅛-in. steel plate in the form of a ring about ¼ in. larger in diameter than the handwheel. This was fixed on the back of the handwheel by three countersunk screws, turned concentric with the handwheel, set up on a dividing head and 50 square teeth milled. The ring was then removed and case hardened.

The boss of the handwheel was also turned to 1 in. diameter concentric with the rim and this carries the rocking cage which holds the spring-loaded pawl engaging with the toothed ring. The pawl can be rotated so that it drives the toothed ring in either direction, giving right- or left-hand feed, or by turning through 90 deg. can be disengaged altogether.

As already mentioned the cross traverse feed is operated by the eccentric and rocking shaft. A lever on the rocking shaft works a push-pull rod which is attached to the gear for altering the rate of feed. This can be clearly seen in Photo No. 3. It consists of a vertical slide pivoted at its centre. There is a quick thread screw running the length of the slide carrying a bronze block which can be screwed from one end of the slide to the other. The screw is rotated by the knob at the top of the slide. From the bronze block is another push-pull rod to the carrier, housing the spring-loaded pawl operating the ratchet wheel.

According to the distance the block is raised above, or lowered below the rocking centre of the slide the arc through which the pawl will rotate increases. The block is raised above the centre for feeding from left to right and depressed below the centre for the opposite feed. This is so that the feed shall always take place on the backward stroke of the cutting tool. The block carries a pointer which moves over an engraved scale on the side of the slide, the figures representing thousandths of an inch feed, from two to twelve. Each tooth of the ratchet gives two thou. feed.

To get a nice surface, plenty of cutting oil is needed and this is ensured by the suds pump which can be seen just below the reduction gearbox and is a small a.c. petrol pump. Cutting oil is pumped over the work, drained into the suds tray and filtered, after which it runs back into the container from which it is pumped round again.

Photo No. 4 gives a good side view of the complete machine. It is particularly smooth working, with a complete absence of chatter even on the heaviest cuts. This is largely due to the flywheel running at 2,000 r.p.m. giving fifty strokes a minute to the ram and to the general rigidity of the angle-iron base and the gearbox housing.

CLUB ANNOUNCEMENTS

Sutton Coldfield and North Birmingham Model Engineering Society

Owing to the room available at the Station Hotel, Station Street, Sutton Coldfield, not being now large enough to house us, all future meetings will be held at the Yenton Hotel, Sutton Road, Erdington, Birmingham, on alternate Tuesdays.

Hon. Secretary: C. F. PALMER, 77, Hartley Road, Kingstanding, Birmingham, 23.

Dundee Society of Model Engineers

The A.G.M. of the above society will be held in the Royal Hotel, Dundee, on Sunday, October 9th, at 2.15 p.m. All interested are cordially invited. Plans for our exhibition in April, 1950, are now well advanced and the society extends an invitation to all "lone hands" in Dundee and Angus who would care to have their models shown, to let the hon. secretary know as early as possible.

Hon Secretary: G. A. MILTON, 10, Forthill Drive, Broughty Ferry.

Eastbourne Society of Model Engineers

Meetings of the above society commenced on Wednesday, September 21st, and are again being held at the Technical School, St. Annes Road, Eastbourne, at 7 p.m. As before, meetings will be held fortnightly.

Hon. Secretary: C. T. UPTON, 13, Lawns Avenue, Eastbourne.

Harrow and Wembley Society of Model Engineers

The last gala day of the season was held by the H. & W. S.M.E. at the Grange, Kenton, on Sunday, September 18th. New interest was created at this meeting by a new 5-in. gauge G.W.R. pannier tank engine built by Mr. C. R. Jeffries, the society's chairman. This engine was undergoing its first track test, and, though unfinished, it shows promise of being a very powerful and handsome locomotive.

Three other engines were running, Mr. A. D. Pole's L.N.E.R. "A5," Mr. E. R. Uphill's $3\frac{1}{2}$-in. gauge "Princess Marina," and Mr. L. J. Lawrance's new $3\frac{1}{2}$-in. gauge tank engine "Juliet."

Hon. Secretary: J. H. SUMMERS, 34, Hillside Gardens, Northwood, Middx.

NOTICES

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. **All such correspondence should be addressed to the Editor (and not to individuals)** at 23, Great Queen Street, London, W.C.2. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

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